RECONNAISSANCE OF THE "RED BED" COPPER DEPOSITS IN SOUTHEASTERN COLORADO AND NEW MEXICO

BY JOHN H. SOULE

• • • • • • • • • **Information Circular 7740**

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John H. Soulé[1]

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[1] Mining engineer, Bureau of Mines, Mount Weather Field Station, Bluemont, Va.

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SUMMARY

This paper describes the location and general features of the "Red Bed" or sandstone copper deposits in southeastern Colorado and New Mexico. Most of the areas containing this type of deposit were visited, and many deposits were examined. Some deposits were not visited because of lack of information as to their location.

In the large area covered a great variety of climatic, geographic, and topographic conditions exists. Some of the deposits are in arid areas, whereas others are in heavily forested regions. Altitudes range from 3,400 to 9,200 feet, and the terrain varies from flat plains to rugged mountains.

Transportation is a difficult problem in most of the districts, involving long truck hauls to a railroad and long rail hauls to a smelter.

These deposits probably were first mined by Indians who prized the more highly colored rocks for ornamental purposes. Some high-grade ores may have been mined by the Spanish explorers, but their operations were not extensive. With one exception most of the production from the deposits was made from 1884 to 1900, and interest since that time has been sporadic. On one property, the major producer, mining was begun in 1925 and continued intermittently to mid-1954. Production of copper to date from the deposits has been about 21,000,000 pounds, largely derived from two widely separated areas.

Although the deposits occur in sedimentary rocks ranging in age from pre-Pennsylvanian through Cretaceous, most of the deposits occur in Permian and Triassic rocks. Most of the copper produced was obtained from deposits in the Triassic formations. Sulfide and carbonate ore minerals predominate and are found in varying proportions. Chalcocite usually is the primary copper mineral; the carbonates were derived by oxidation of the chalcocite.

The sedimentary rocks in which the deposits occur vary from nearly pure sandstones to arkoses, with the latter predominating. The textures of the rocks range from shales through sandy shales, sandstones, and grits to conglomerates. The copper mineralization often is widely distributed but rarely continuous. Most of the deposits in the area are small.

Mining methods varied from simple "gophering" to room-and-pillar and small-scale open-pit operations. Few of the deposits are developed to any great extent, and the deepest known penetration of an ore bed was by an inclined shaft over 1,200 feet long. The bottom of the shaft was about 500 feet vertically below the surface. Another deposit was mined by open-pit methods for about 1,500 feet and to a maximum depth of about 30 feet.

Many treatment plants have been erected in the various districts. Small smelters, leaching plants, and concentrators have been tried, with little success. Most of the ores were shipped directly to a smelter. An ammonia leaching plant,

the first to be tried on "Red Bed" ore, is now being built and, if successful, will undoubtedly result in a renewed interest in copper deposits of this type.

INTRODUCTION

This paper is one of a series relating to the mineral resources of the Nation. It briefly describes the location, general features, and treatment of the "Red Bed" or sandstone copper deposits in southeastern Colorado and New Mexico. Locations of the numerous deposits are shown on figure 1.

In preparing this report, all but one of the areas containing "Red Bed" copper deposits were visited, although not all of the properties could be located. Published data were freely drawn upon, and the proper credit has been given. An attempt was made to prepare as complete a report as possible, but there probably are deposits in the area that have not been reported in the literature and so are not covered here. Some that were reported could not be found because of insufficient data on their locations. Many of the prospects were worked on a small scale 50 or more years ago and have since been forgotten. Some of these deposits were in localities where even long-time residents have forgotten them. A few deposits were visited that were not "Red Bed" deposits, and some of the reported prospecting was done in areas barren of copper.

This investigation of the "Red Bed" copper deposits was begun in March 1954 and completed in July 1954. Accessible workings of extent were mapped by reconnaissance methods. Many samples were taken, which were analyzed in the Bureau of Mines laboratories at Salt Lake City, Utah, and Tucson, Ariz. An effort was made to obtain samples representative of material that could be mined; but this was not always possible, and some of the samples can be considered as only indicative.

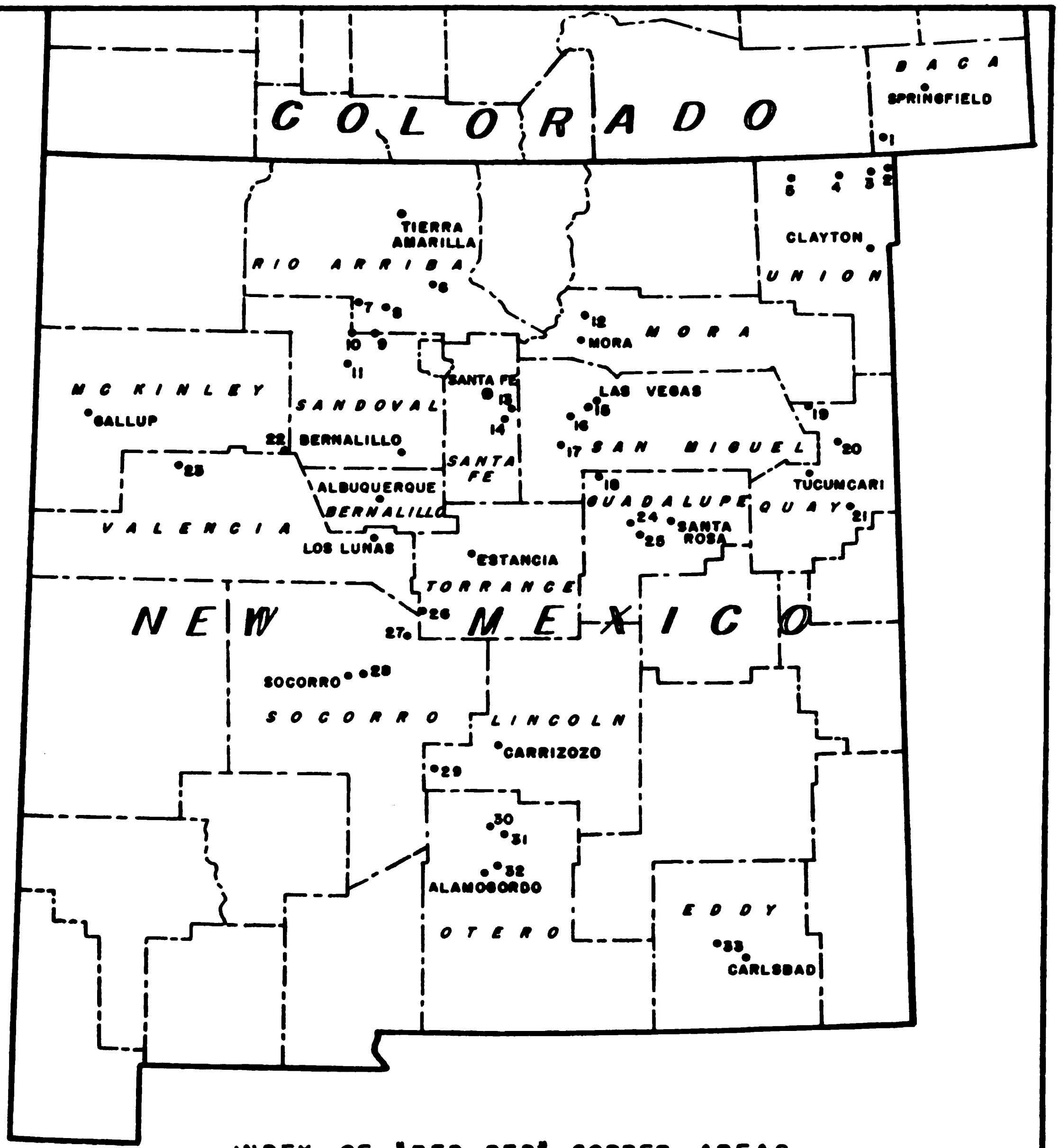
Special attention was given to locating the deposits so that it would be possible for others to find them in the future. It often was difficult or impossible to correlate names and mines, and in many instances even the mine names were not known. Index maps are included for most of the areas containing "Red Bed" copper deposits.

ACKNOWLEDGMENTS

Acknowledgments are due to various ranch owners who allowed access to some of the deposits and to persons who furnished directions and interesting historical and statistical data. Many county records were examined for dates and locations of mining claims. Maps by the New Mexico State Highway Department, the Federal Geological Survey, and Forest Service were used in this work. Much of the material was taken from files of the former Silver City, N. Mex., Bureau of Mines field office.

PHYSICAL FEATURES AND COMMUNICATIONS

The "Red Bed" copper deposits reported in this paper are widely distributed throughout eastern and northern New Mexico and the adjacent part of southeastern Colorado. A great range of topographic and climatic conditions exist in these areas. The deposits in New Mexico lie at altitudes ranging from about 3,400 feet near Carlsbad to a little over 9,200 feet near Cuba. The terrain varies from nearly flat in the lower altitudes to quite mountainous and rugged in the higher. The deposits in southeastern Colorado are just north of the Colorado-New Mexico border and are similar geographically and climatically to those in northeastern



INDEX OF "RED BED" COPPER AREAS

1. SOUTHEASTERN COLORADO
2. NORTH CIMARRON
3. FT. PITT
4. PEACOCK CANYON
5. FOLSOM
6. ABIQUIU
7. GALLINA
8. COYOTE
9. JAROSA
10. COPPER CITIES
11. SAN MIGUEL
12. GUADALUPITA
13. PAYTIAMO
14. GLORIETTA
15. MONTEZUMA
16. MINERAL HILL
17. TECOLOTE
18. ANTON CHICO
19. GALLEGOS
20. LOGAN
21. LLANO ESTACADO
22. MC KINLEY COUNTY
23. ZUNI MOUNTAINS
24. PINTADA LODE
25. GUADALUPE
26. SCHOLLE
27. RAYO
28. CHUPADERO
29. ESTEY
30. TULAROSA
31. BENT
32. SACRAMENTO
33. LONE EAGLE

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Figure 1. - Location map of "Red Bed" copper deposits in southeastern Colorado and New Mexico.

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New Mexico. They occur at altitudes of approximately 5,000 feet at the base of escarpments.

The climate varies with the altitude, with hot summers and mild winters in the lower areas and cool summers and rigorous winters in the high mountains. Precipitation usually increases with an increase in altitude. Vegetation ordinarily is scanty at the lower altitudes, but there are beautiful stands of timber at the higher elevations.

Most of the areas are relatively isolated, being served by poor roads at best and in some instances by no roads at all. The distances to the nearest rail points range from 2 to as much as 70 miles. Rail transportation from the nearest rail points to the smelters at El Paso, Tex., ranges from 87 to nearly 700 miles. The transportation problem constitutes one of the more serious and disadvantageous economic features pertaining to operation of these deposits.

HISTORY AND PRODUCTION

"Red Bed" copper deposits are common in the southwestern part of the United States, and interest has been shown in them at various times. The first mining on the deposits in southeastern Colorado and New Mexico may have been done by Indians who prized the more highly colored rocks for ornamental purposes. Spanish explorers may have done a little work on a few deposits where exceptionally high grade ore was available. However, little real work was done until the latter part of the 19th century. Interest reached a climax about the turn of the century and waned thereafter, with a slight revival of interest during World War I. Little attention has been given to the deposits since that time, except for an occasional attempt at operation. During this century, only one deposit - that in Guadalupe County, N. Mex. - has produced an appreciable quantity of copper ore. Operations were begun at this mine in 1925 and were continuing in mid-1954; however, the mine was idle in many of the intervening years.

In spite of the early interest shown in the deposits, none of the operations had a long life, and many were failures from an economic viewpoint. A number of reasons can be given for the failures. The most important of these are: The generally small size of the deposits and the low grade of the copper mineralization in some; the relative isolation; and the lack of a simple metallurgical process for treating mixed ore.

The total production of copper in the area to date from this type of deposit, as reported by this paper, approximated 21,000,000 pounds of copper. By far the largest part of this production was derived from two widely separated areas, Guadalupe and Sandoval Counties in New Mexico. It is doubtful if the production from outside of the two areas exceeded 3,000,000 pounds of copper. Recorded "Red Bed" copper production is shown, by counties, in table 1.

GENERAL GEOLOGY

Although the various "Red Bed" or sandstone copper deposits show many points of similarity, the age of the rocks in which they occur ranges from pre-Pennsylvanian through lower Cretaceous. Most of the deposits are in Permain and Triassic formations, and deposits in each may be only a few miles from each other. For example, in Guadalupe County, N. Mex., the Stauber mine is in the Santa Rosa sandstone member of the Dockum series of Triassic age, whereas 5 miles away the Pintade lode deposits occur in the Yeso sandstone member of the Chupadera formation of Permian age.

Other deposits were noted in the Purgatoire formation of Lower Cretaceous age, whereas one deposit, an unimportant one, was noted in a green shale between the Magdalena formation of Pennsylvanian age and the underlying pre-Cambrian basement. Deposits in the Triassic rocks are the most important in the area covered, and by far the largest part of the production has been obtained from them.

TABLE 1. - Production of "Red Bed" copper, by counties

State	County	Tons	Gross metal content			
			Ounces		Pounds	
			Gold	Silver	Copper	Lead
Colorado	Baca1/	28		356	21,511	
New Mexico ..	Bernalillo2/					
	Eddy	168		21	22,036	
	Guadalupe	220,475		42,494	12,004,437	58,723
	Lincoln	234		124	42,265	
	Mora1/	37		40	6,315	
	Otero	29,288	1.15	4,117	939,092	1,853,027
	Quay					
	Rio Arriba	21	.12	31	2,898	
	Sandoval	6,379	.41	8,921	6,560,546	
	San Miguel	596	19.	128	19,112	2,816
	Santa Fe2/					
	Socorro2/					
	Torrance	10,776	24.14	8,432	1,050,047	296
	Union2/					
	Valencia	611		302	41,595	1,304
Total		268,613	44.82	64,966	20,709,854	1,915,578

1/ Recoverable metal.
2/ No "Red Bed" production recorded.

Some copper mineralization was noted in shale, much in sandy shales and fine sandstones, considerable in coarser sandstones and grits, and some in conglomerates. In general, richer ore was noted in the finer grained sandstones and sandy shales, but the ore usually was quite thin. Larger dimensioned ore bodies were noted in the coarser grained rocks, but the grade usually was lower. The host rocks vary from high-silica sandstones to arkoses with an arkosic composition predominant. The petrologic composition of the rocks is important in the case of direct-smelting ores because a silica content higher than the alumina content often commands preferential smelting rates. Many of the deposits do not contain ores with the combination of high silica and low alumina content necessary to a desirable fluxing ore.

The name "Red Bed" seems to be a misnomer, as the copper minerals almost always occurred in light beds varying in hue from white through gray, with occasional tints of yellow and pink. The pink usually is due to the pink grains of feldspar. The light color seems to be due to a bleaching action in a few instances, but in the majority of the deposits it seems as though the rocks always have been light. Frequently, however, the light copper-bearing beds are sandwiched between decidedly red rocks. This applies especially to deposits occurring in the Abo formation of Permian age. A few deposits occur in dark rocks.

Chalcocite almost always was the principal primary copper mineral. Malachite and azurite, oxidation products of the chalcocite, occur in most of the deposits. In some deposits all of the chalcocite was oxidized, whereas in others only a little oxidation was seen. Most of the deposits contain both sulfide and carbonate

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minerals. Chrysocolla is sparingly present in a few deposits, and bornite, covellite, and melaconite are minor minerals in some of the deposits. Pyrite and its oxidation products rarely were seen with the copper minerals but often were noted nearby. Some of the deposits contain appreciable lead. In the Sacramento district, Otero County, N. Mex., some deposits were mined for their lead content, which greatly exceeded the copper content of the ores.

The copper mineralization occurs as fissure filling, as patches replacing the cementing material between the rock grains, as partial or complete replacement of carbonaceous material, as disseminations replacing certain mineral grains of the rock, as interstitial filling, and as nodules within the rock. Mineralization seems to have been selective in that only certain beds of a formation contain copper minerals. Most of the deposits in an area are confined to a single stratigraphic unit of a formation, but occasionally they occur in more than one unit of the same formation.

The source and placement of the primary copper minerals pose questions that have puzzled geologists, and various theories have been set forth to explain this. It is possible that no one theory will account for the mineralization of all of the deposits and that various areas were mineralized by different geological phenomena.

Structural deformation is evident in every area. This may vary from a slight flexing of the sedimentary beds to severe localized folding and faulting. Coarse jointing is common, and brecciation is rare. Regional deformation varies from slight to severe. The mineralized beds range from flat lying to nearly vertical. Low-angle dips predominate.

MINING OPERATIONS

In the operations that progressed beyond the prospect stage, simple mining methods were used to mine the "Red Bed" copper deposits. At the Stauber mine in Guadalupe County, N. Mex., the first mining was done by simple room-and-pillar methods, with entry by shallow shafts. Partial reclamation of the pillars by retreating was practiced during the first period of operation. Later, at about the time of World War II, open-pit methods were introduced, and many pillars left by previous mining, as well as much new ore, were mined. In 1954 the ratio of overburden to ore became excessive, and underground mining was reverted to. The reversion was simple as entry to the various ore faces was made from the pit. Most of the pit equipment was used for the shallow underground work.

At the San Miguel mine in Sandoval County, N. Mex., considerable ore was mined, but the inaccessibility of the workings prevents their description. Most of the other deposits were developed by drifts or shafts, depending upon the attitude of the ore bed. Most workings were shallow.

A variety of plants have been erected to treat the ores, but most of them were unsuccessful. The plants included small smelters, concentrating mills, and leaching plants. Most of the ores were too low grade to be smelted direct, although a considerable production was made by this method from a group of mines in Sandoval County, N. Mex. The ore from these deposits was hand-sorted to a high grade. Local coal, of which there are large reserves, was used as fuel for the smelting. Acid leaching processes have been tried but were unsuccessful, partly because the sulfides of the mixed sulfide-carbonate ores were insoluble in sulfuric acid. This sulfide-carbonate ore also is difficult to beneficiate with simple flotation or gravity plants because the carbonates and silicates float with difficulty, and the same minerals also are difficult to recover by gravity methods. More expensive double-treatment plants probably would give satisfactory metallurgical results, but most of the ore bodies contain insufficient reserves to justify establishing such a plant. In mid-1954, only two of the deposits were being worked. In one, which has had considerable production, the high silica content of the ore and a 2-mile truck haul to the railroad are favorable economic factors. In the other an attempt is being made to treat the ores by an ammonia leaching process. At the time of the visit, the plant was just being completed and had not begun to operate. If success-this type of plant may lead to exploitation of many deposits that are uneconomic due partly to their relative isolation.

"Red Bed" Copper Deposits in Southeastern Colorado

"Red Bed" copper deposits occur in southeastern Colorado in the southwestern part of Baca County. All are on the Dunlap ranches and in T. 34 S., R. 50 W. and south of the juction of East and West Carrizo Creeks, as shown on figures 2 and 3. All of the deposits are similar in mineralogy and occur within the same stratigraphic horizon.

The area of the copper deposits is reached by traveling west, then south from Pritchett, Colo., on U. S. Highway 160 for 8 miles, then south on a county road for 2 miles, west for 2 miles, and south for 7 miles. From the stone house at this point, the route leads west for 2 miles to the Dunlap-Mizer mailboxes, southwest on a ranch road for 5 miles to the junction of East Carrizo and West Carrizo Creeks, and south down Carrizo Creek for 1 mile to the Walter Dunlap ranch house. One group of deposits lies about one-half mile northwest of this ranch house. By traveling south from the ranch house, down Carrizo Creek for 1 mile to the arched gate and cattle guard of the Dunlap ranch, Skull Canyon is reached, and the Independence and other deposits lie about three-fourths mile to the west and up Skull Canyon. By continuing south past the arched gate for one-half mile and west up Bear Canyon for about 1 mile, the Jackpot group of deposits is reached. A location map is shown as figure 3. Pritchett is the nearest rail point and is about 28 miles by road northeast of the deposits.

The Independence mine probably was the first located in the area. This location was made in 1889, and subsequent relocations have been made. This deposit also is the most extensively developed of the district and probably is the only one from which any production was made; this output is tabulated as follow.

TABLE 2. - Recorded production of the Independence mine[1]

Years	Ore, tons	Gold, ounces	Silver, ounces	Copper, pounds	Total value
1900, 1901, 1902	-	14	241	11,419	$2,242
1915, 1916, 1917	14	-	115	10,092	2,717
				21,501	

[1] Vanderwilt, J. W., Mineral Resources of Colorado: State of Colorado Mineral Resources Board, 1947, p. 32.

In 1923 some ore reportedly was shipped to a smelter at Pueblo, Colo., and later some ore was smelted at the property, but there is no known record of any shipments or sales of smelted copper products.

Copper mineralization observed was confined to the basal member of the Purgatoire formation of Lower Cretaceous age. This member is a light, crossbedded,

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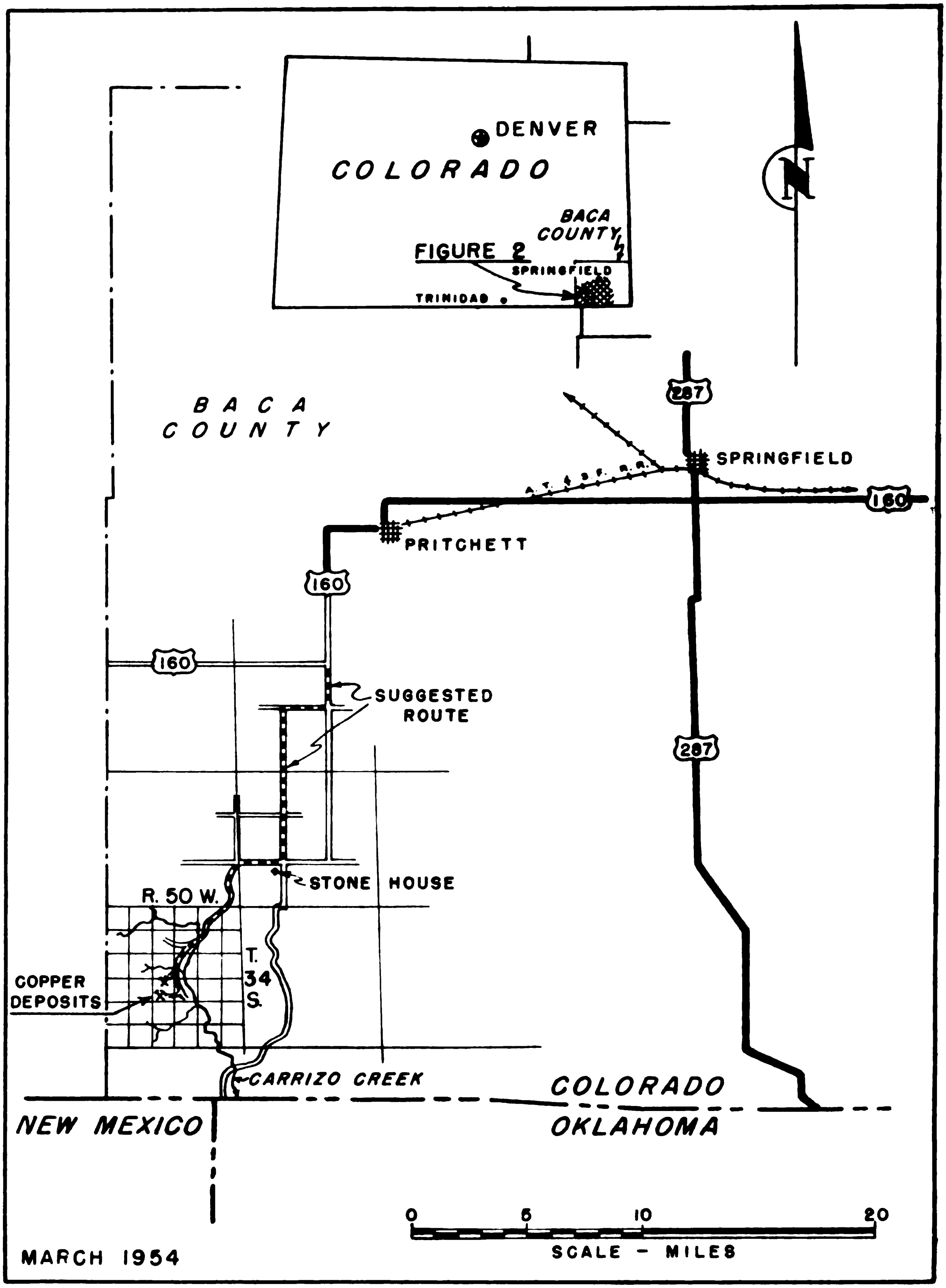


Figure 2. - "Red Bed" copper deposits, southeastern Colorado.

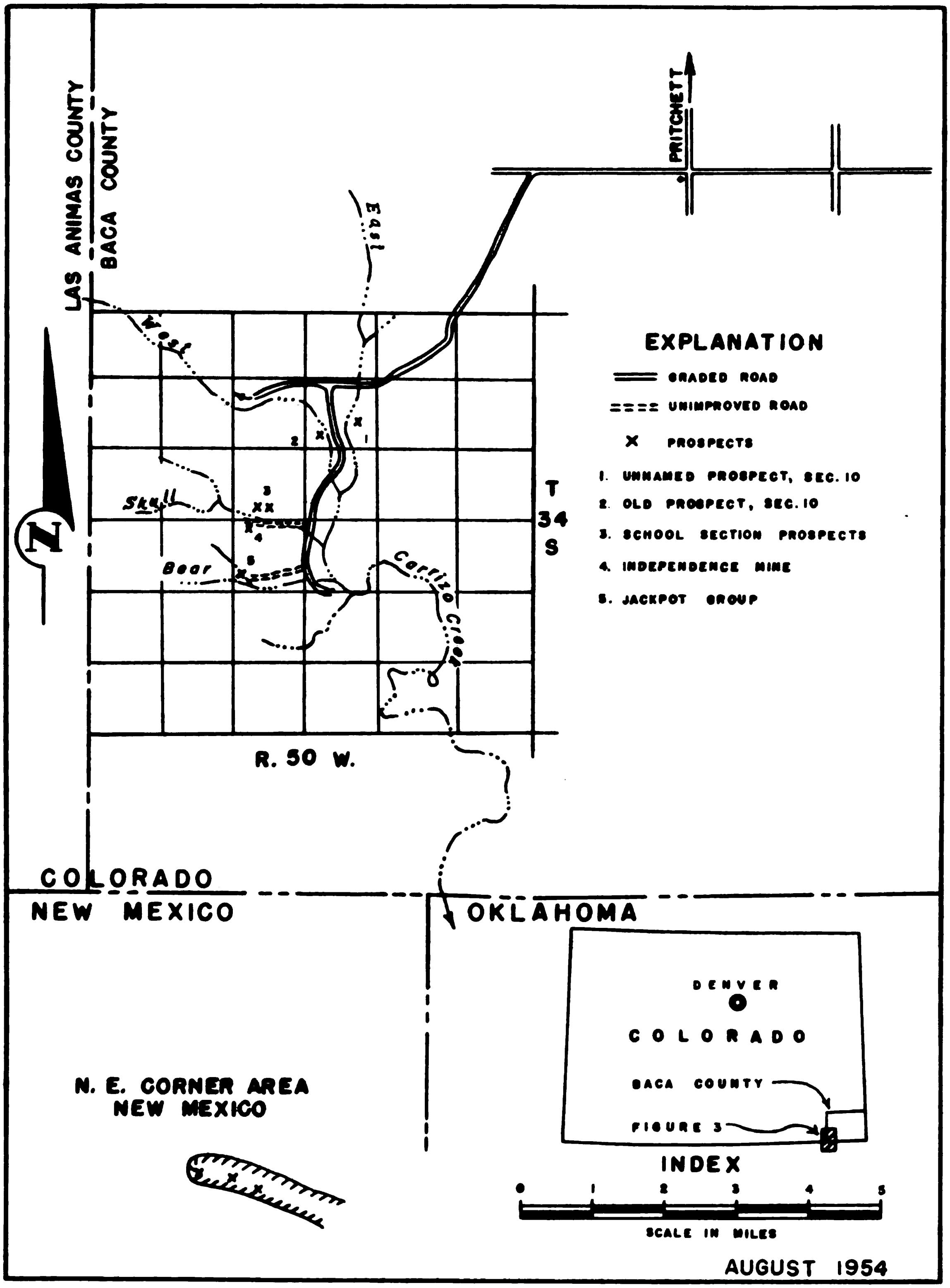


Figure 3. - Southeastern Colorado deposits, Baca County.

porous, arkosic sandstone. The grain size is medium to fine. Possibly 30 percent of the rock grains are feldspar.

The stratigraphic section at the mine consists of the above basal sandstone, which is about 14 feet thick. This is overlain by about 10 feet of slabby sandstone, which becomes more massive to the east. This, in turn, is overlain with about 33 feet of iron-stained shales and sandy clays, followed by about 40 feet of unstained shales and sandy clays. The top of this Purgatoire section and the bottom of the overlying Dakota sandstone could not be determined because of talus. A stratigraphic section is shown as figure 4. The sedimentary formations are flat lying, with a very slight north dip. Underlying the above formation are the Morrison shales. All of the sedimentary series can be traced for miles to the south and east. The Purgatoire and the Dakota formations can be traced for miles to the north and west.

There is very little structural deformation in the area. Steeply dipping faults were noted; but these were few, and displacement is small. Probably the most important structural feature is a gentle flexing of the beds and the attendant fracturing, in which the bulk of the copper minerals were deposited. This fracturing is rather widely spaced, ranging from a few inches to a few feet apart. The zone of fracturing may have a trend, but individual breaks may strike any direction. Most of the fractures are narrow and steeply dipping.

The copper minerals are chalcocite and malachite, with occasional azurite. Chalcocite probably was the original copper mineral, and the carbonates were derived by oxidation of the chalcocite. In some of the very thin fractures all of the chalcocite has been altered to malachite, whereas some of the thicker stringers show a core of chalcocite bordered by malachite. The stringers may average about one-fourth inch in thickness, but local bulges to 1 inch were noted. In spite of the porous nature of the sandstone there is very little deposition of copper away from the fractures. A few small patches of disseminated mineralization were noted, as well as some deposition along bedding planes. No carbonaceous material was noted in the formation.

Attempts were made to trace the copper mineralization along the outcrops, but this could be done for only short distances, usually less than 100 feet. That the mineralized zones could have considerable length is indicated by a 524-foot adit on the Independence claim. As exposed in this adit, the quantity of mineralization seems to decrease with an increase in distance from the outcrop.

The Independence Mine

This property was the first claim in the area, and this location reportedly was made in 1889. From county records subsequent locations have been made after previous ones were allowed to lapse. The property is in the NW1/4 sec. 21, T. 34 S., R. 50 W. on the south side of Skull Canyon. The deposit is developed by a 524-foot adit and by two crosscuts at the 200-foot point that develop the zone to a width of 61 feet. A second adit was begun about 75 feet west of the main adit and entered the mineralized bed for about 34 feet. The walls of this adit contain copper minerals, and the mineralized zone is traceable for about 100 feet along the outcrop. These workings are shown on figure 5. The thickness of the bed is about 14 feet at the portal and about 5 feet at the face of the long adit. The underlying Morrison shales appear in the bottom of the last third of the adit.

The crosscuts in the main adit were sampled, and the results of this work are shown on figure 5.

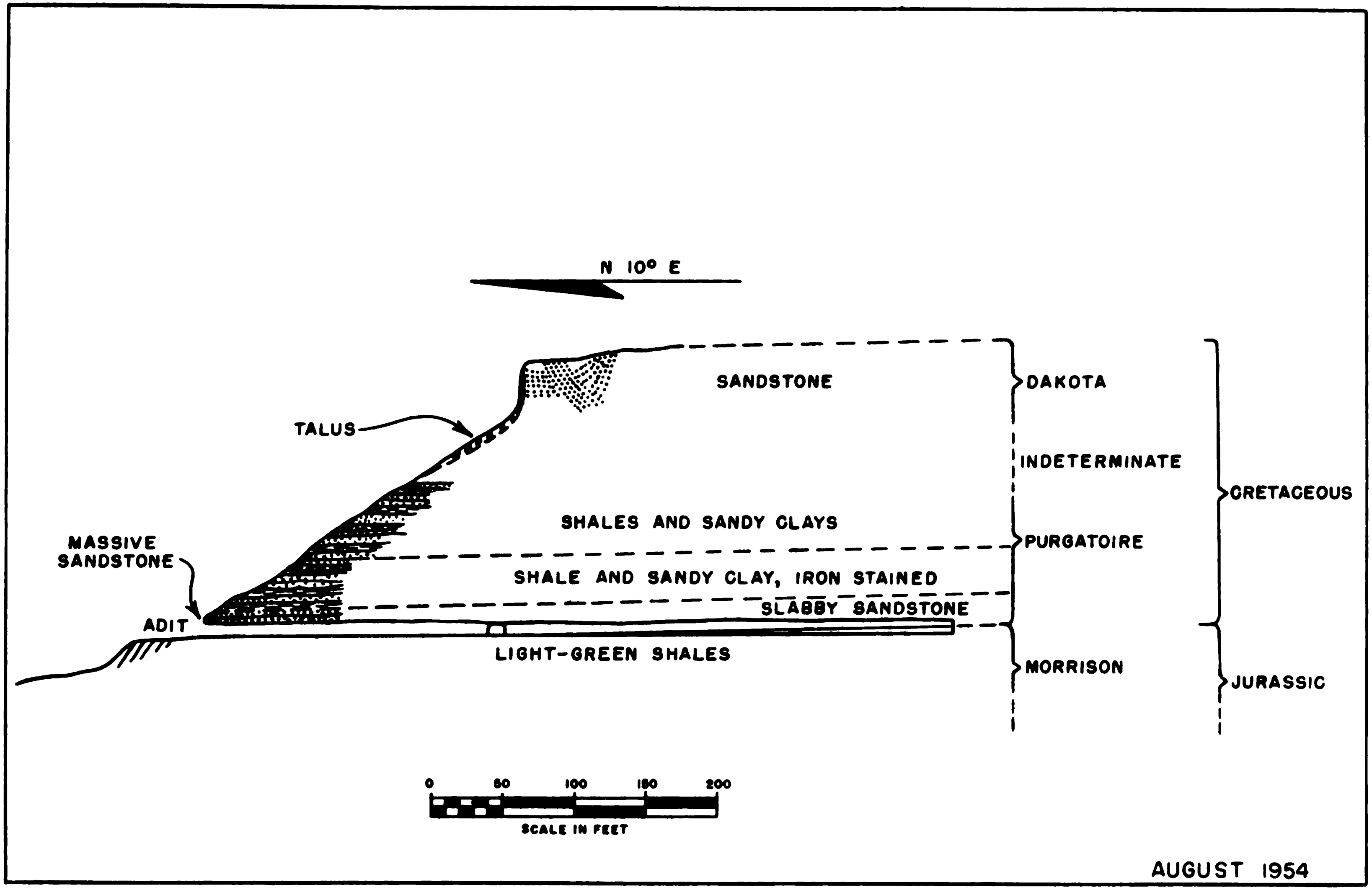
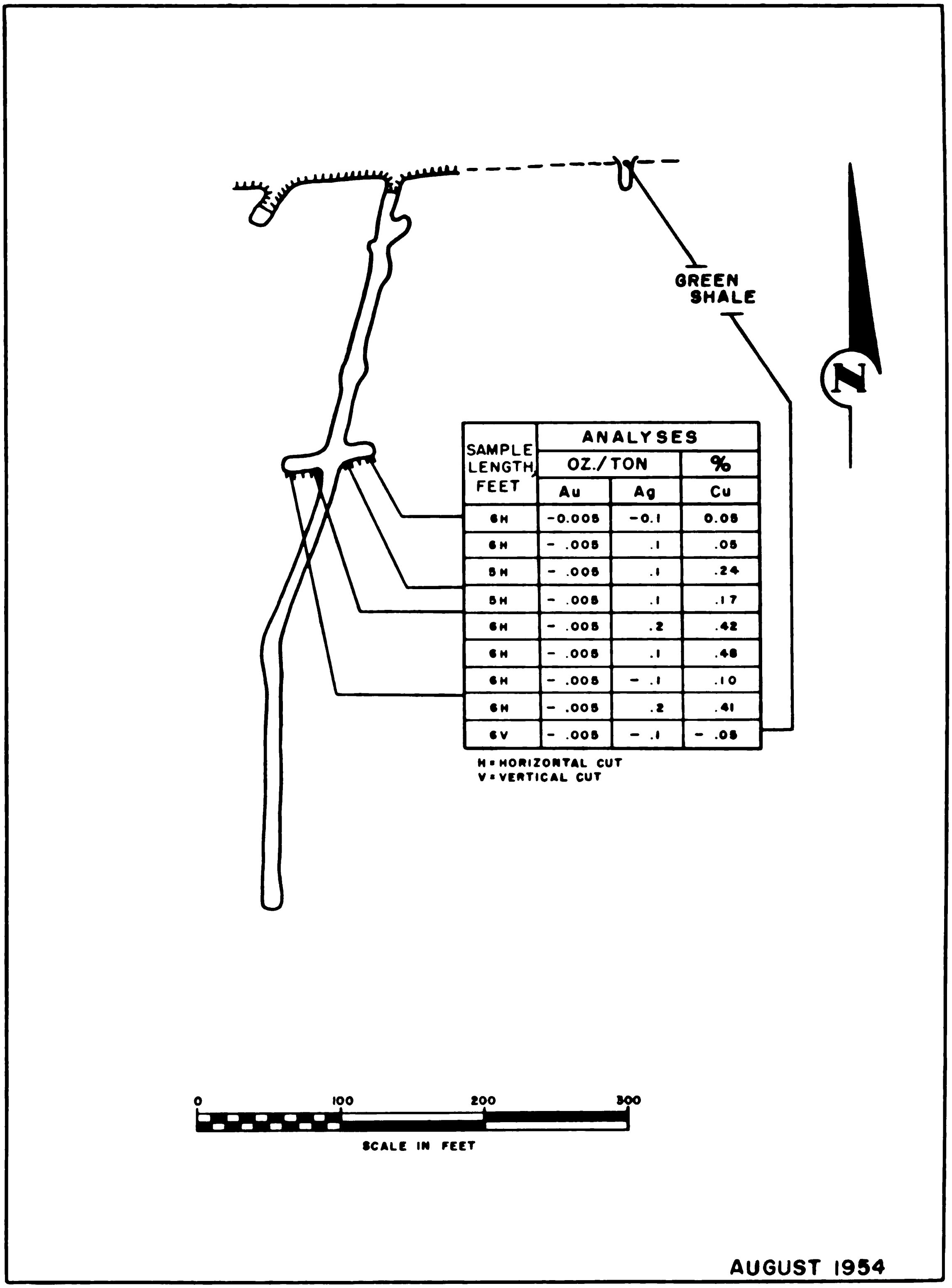


Figure 4. - Vertical section showing Independence mine and local stratigraphy.



SAMPLE LENGTH, FEET	ANALYSES		
	OZ./TON		%
	Au	Ag	Cu
6H	-0.005	-0.1	0.05
6H	- .005	.1	.05
5H	- .005	.1	.24
5H	- .005	.1	.17
6H	- .005	.2	.42
6H	- .005	.1	.48
6H	- .005	- .1	.10
6H	- .005	.2	.41
6V	- .005	- .1	- .05

H = HORIZONTAL CUT
V = VERTICAL CUT

AUGUST 1954

Figure 5. - Plan and assay map, Independence mine, Colo.

Past mining resulted in a small production, largely from sorted ore. Attempts were made to smelt the ore on the property, but this operation evidently was short lived.

Deposits on School Section 16

On the north side of and just across Skull Canyon from the Independence mine is a deposit upon which a little work was done. This deposit is in the SW1/4 sec. 16, T. 34 S., R. 50 W. The mineralization is similar to that of the Independence mine but seems to be more limited in extent. The work done consists of open pitting along the scarp of sandstone and the beginning of a small shaft about 3 feet deep. A dump sample contained 0.56 percent copper, 0.10 ounce of silver per ton, and no gold.

About 500 feet east of the above deposit and on the north side of Skull Canyon a little work was done on a stringer containing copper minerals. The mineralization is the same as previously described but was confined to a single fracture. Just east of the portal excavation was made for a small smelter, which evidently was never installed.

Bear Canyon Deposits

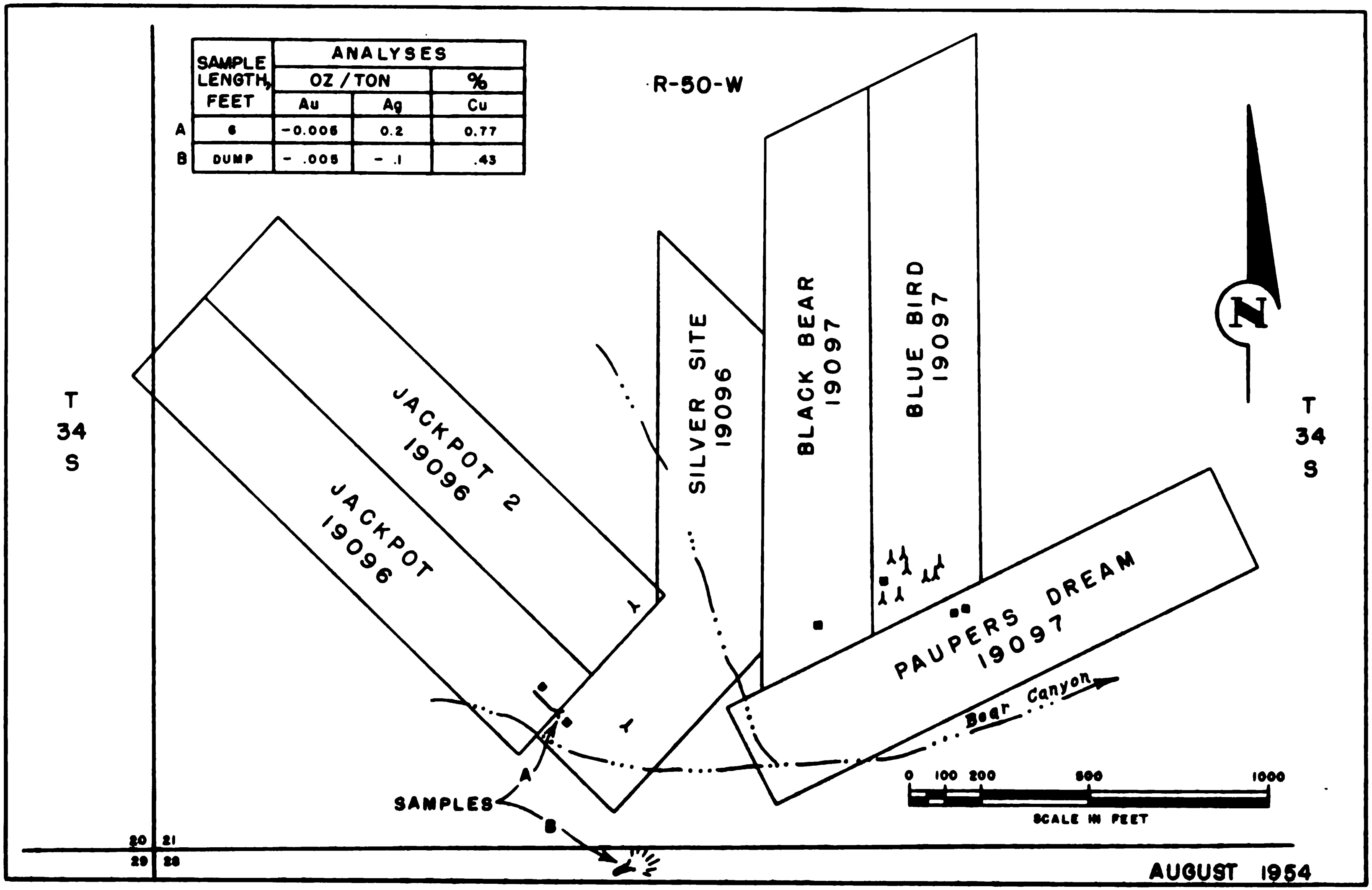
In the SW1/4 sec. 21, T. 34 S., R. 50 W., nearly 1 mile south of the Independence mine, is a group of deposits of similar mineralization. Most of these deposits are covered by patented claims, which are shown on figure 6. From the county records this group of claims was owned in 1954 by R. C. Marr, 441 Cambridge Drive, Arcadia, Calif.

Considerable work was done on the claims, the most important of which are shown on figure 7. An 85-foot adit on the Jackpot claim developed a deposit which indicated a mineralized thickness of bed of about 8 feet. An air shaft connected to the surface from a crosscut located near the face of the adit. One sample was taken at the portal of the adit, and the results are shown on figure 7. A shaft of considerable but unknown depth was sunk near the portal and entered the Morrison formation after a few feet. Most of the work was done in these shales, in which no copper mineralization was noted. Some open-pit work was done between the shaft and the adit portal. This disclosed the usual copper mineralization. The mineralized outcrop could not be traced far beyond the mine workings. Many other lesser workings occur on the claim group, a number of which were done in the barren Morrison shales.

About 500 feet southeast of the Jackpot adit portal some work was done on another deposit. The workings were filled. The outcrop of the mineralization could not be traced because of alluvium. One sample was taken of the dump material, and the results are shown on figure 7.

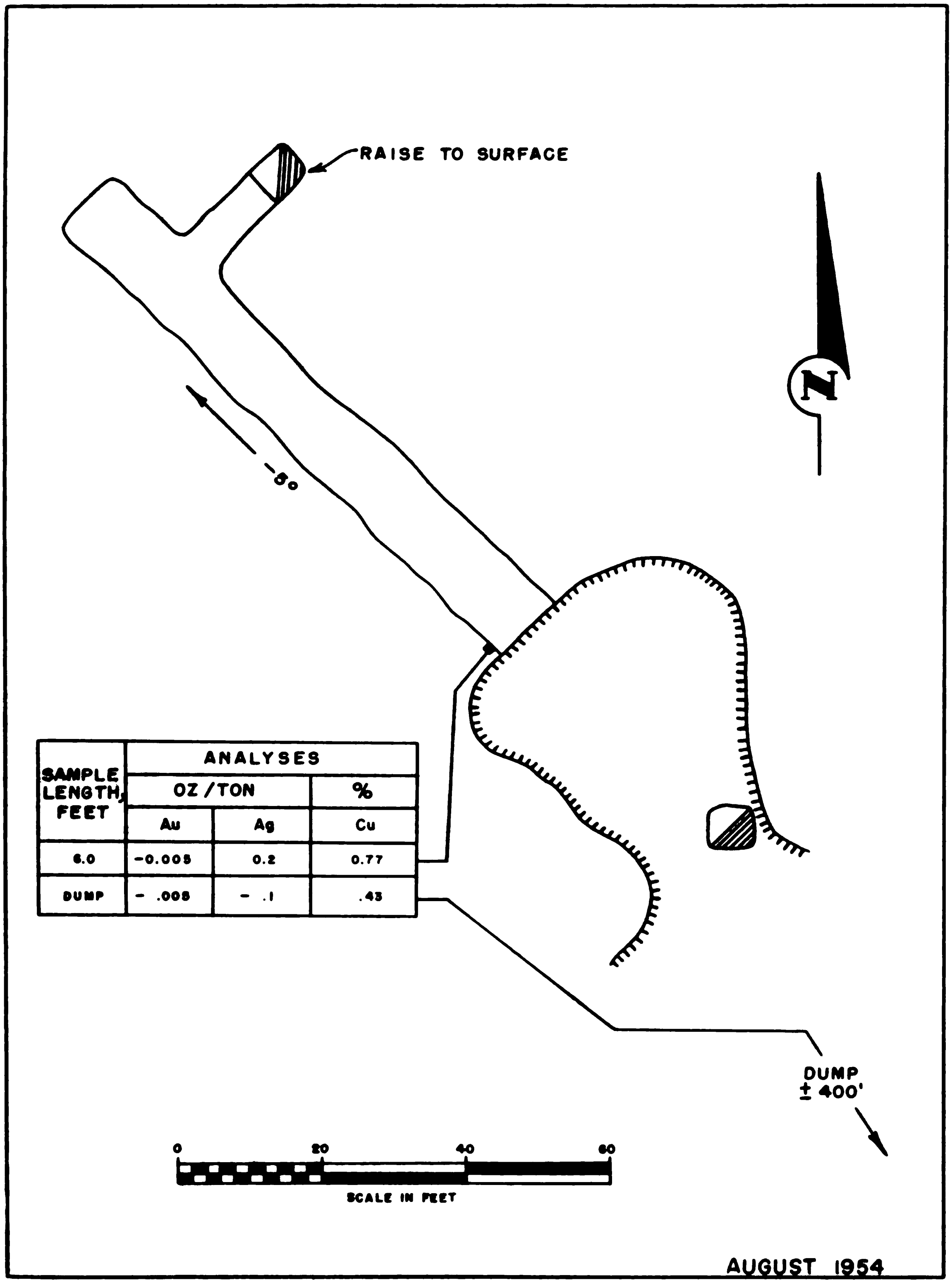
Old Workings in Section 10

Less than 1 mile south of the junction of East Carrizo and West Carrizo Creeks and northwest of the Walter Dunlap ranch house some shallow work was done on a deposit situated in the SW1/4, sec. 10, T. 34 S., R. 50 W. The mineralization here is the same as in the other deposits but is more limited in extent. There is no known history of this deposit, and the ruins of old stone buildings and an old smelter site give mute evidence of past attempts at operation. These were short lived, as the smelter slag pile is small and the mine workings are shallow.



	SAMPLE LENGTH, FEET	ANALYSES		
		OZ / TON		%
		Au	Ag	Cu
A	6	-0.005	0.2	0.77
B	DUMP	- .005	- .1	.43

Figure 6. - Jackpot group patented claims and mine workings in Bear Canyon, Colo.



SAMPLE LENGTH, FEET	ANALYSES		
	OZ/TON		%
	Au	Ag	Cu
6.0	-0.005	0.2	0.77
DUMP	- .005	- .1	.43

Figure 7. - Sketch plan and assay map, Jackpot mine, Colo.

East of these workings on the east bank of Carrizo Creek and in sec. 10, T. 34 S., R. 50 W., copper minerals are reported in the same sandstone member of the Purgatoire formations. Mineralization here is scanty.

"Red Bed" Copper Deposits in New Mexico

"Red Bed" copper deposits are widely distributed throughout New Mexico, as shown on figure 1. There are more than 75 separate deposits or mineralized zones occurring in 34 general districts or areas (see fig. 1). Small quantities of copper have been produced from some of these areas but in only three, the San Miguel mine in Sandoval County, the Stauber mine in Guadalupe County, and the Virginia mine in Otero County, can the production be considered significant. The Stauber mine was in operation early in 1954. The ores from this mine have a high silica content and are valuable for their fluxing qualities.

Copper minerals occur in sandstone and allied types of rocks ranging in age from pre-Pennsylvanian through Cretaceous. Nearly all of the copper deposition seems related to some structural feature, even if minor. In some deposits copper minerals replaced carbonaceous material that occurred in the rocks. In still others, woody fragments were untouched by the copper minerals.

The various deposits and mineralized areas in the State are described, by counties, in the following sections. All coordinate locations pertain to the New Mexico Principal meridian.

Deposits in Union County

Union County is the most northeasterly county of New Mexico and is partly adjacent to Baca County, Colo., in which the previously described deposits occur. No officially recorded production has been attributed to the deposits from this county, although legendary production is reported by local residents.

County records indicate that activity in the district was begun about 1900 and was short lived. The Fort Pitt Co. was in existence in 1912, but all mining probably had ceased long before then. The various areas are discussed in the following sections.

Deposits North of the Cimarron River

Along the base of the escarpment bordering the Cimarron River on the north and extending westerly from the Oklahoma State line are a group of deposits mineralogically similar to the deposits in southeastern Colorado. The deposits extend from secs. 7, 8, and 17, T. 31 N., R. 37 E. through secs. 11 and 12, T. 31 N., R. 36 E., as shown on figure 8. Claim names were Copper King, Copper Chief, and others. Similar deposits occur just east in Oklahoma.

The above deposits are accessible to motor vehicles, although some of the roads are no more than trails. Much of the valley adjacent to the escarpment can be traversed by car without benefit of roads. The area is relatively isolated from rail transportation, and the nearest rail points are Boise City, Okla., some 45 miles to the east and Clayton, N. Mex., some 45 miles to the south.

All of this series of deposits occurs in the massive sandstone bed at the base of the Purgatoire formation. Copper mineralization is spotty in the area and locally. Near the west end of this group of deposits one was developed by a

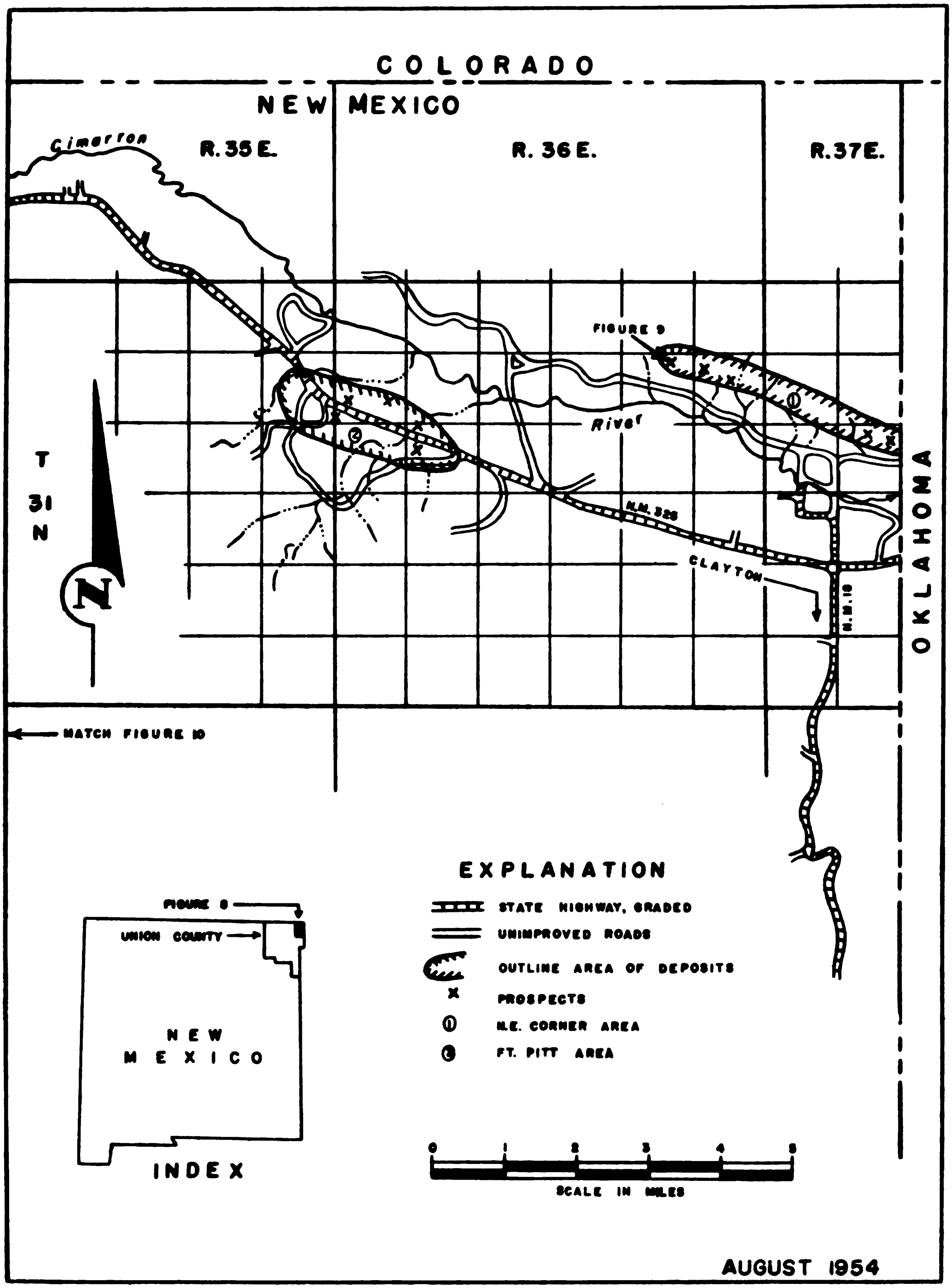


Figure 8. - North Cimarron and Fort Pitt areas, N. Mex.

200-foot adit, as well as by shallower workings, which are shown on figure 9. Here the flat-lying basal Purgatoire sandstone has been coarsely brecciated until a chaotic jumble of sandstone resulted. There is little or no apparent displacement of the sandstone beds on either side of the brecciated zone, and there is no apparent displacement of the overlying Dakota sandstone. This breccia is limited in extent along the outcrop and may have resulted from compaction and adjustment within the sedimentary beds.

Copper mineralization is sporadically distributed in the jumbled sandstone in streaks, patches, and disseminations. The mineralized patches are small, and the overall grade of the mass is very low. One sample taken from dump material contained 0.02 percent copper and traces of gold and silver. Malachite is the predominant copper mineral.

The Fort Pitt Deposits

About 6 miles west of the above deposits on the south side of the Cimarron River and astraddle New Mexico State Highway 325 lie the Fort Pitt deposits, as shown on figure 8. They are in secs. 7, 8, 17, and 18, T. 31 N., R. 36 E., and in adjoining secs. 12 and 13, T. 31 N., R. 35 E. The deposits are easily accessible by motor vehicle, and the nearest rail points are Boise City, Okla., about 47 miles east and Clayton, N. Mex., about 47 miles to the south.

Activity in this area dates back to 1899, when the Union, Iron Bird, Empire, Baby Mine, Black Hawk, Hidden Treasure, andother claims were located. The Sater Copper Co. was organized in 1903 or 1904, to be followed by the Fort Pitt Copper Co. from 1907 to about 1912.

The deposits are characterized by small red hills rising a maximum of only a few tens of feet above the valley plain. The hills have small area extent and are highly mineralized with hematite. A small amount of manganese oxide may be present. The mineralized areas are too limited in extent to be considered a source of iron ores.

The basal Purgatoire sandstone is the predominant surface rock, although the underlying Morrison shales are exposed in some of the creekbeds. The mineralized hills are of the basal Purgatoire sandstone. The hematite mineralization seems to have ascended through chimneylike sets of fractures.

No copper minerals occurred with the heamtite, but they were noted in close proximity. The copper mineralization was scant. All development was by shaft and shallow pits. A sample of hematite from the Fort Pitt dump contained no gold, silver, or copper.

The smallest and most northerly of the red hills is the site of the Fort Pitt mine. A shaft was not accessible, but a description is quoted from the literature.[2] "A shaft, sunk by this company in the most conspicuous outcrop in the canyon, is reported to be 380 feet deep and is said to have a moderate amount of drifting from it at level intervals of 50 feet."

As this shaft collars in the basal Purgatoire sandstone, it undoubtedly penetrated the underlying Morrison formation and probably into the Dockum formation.

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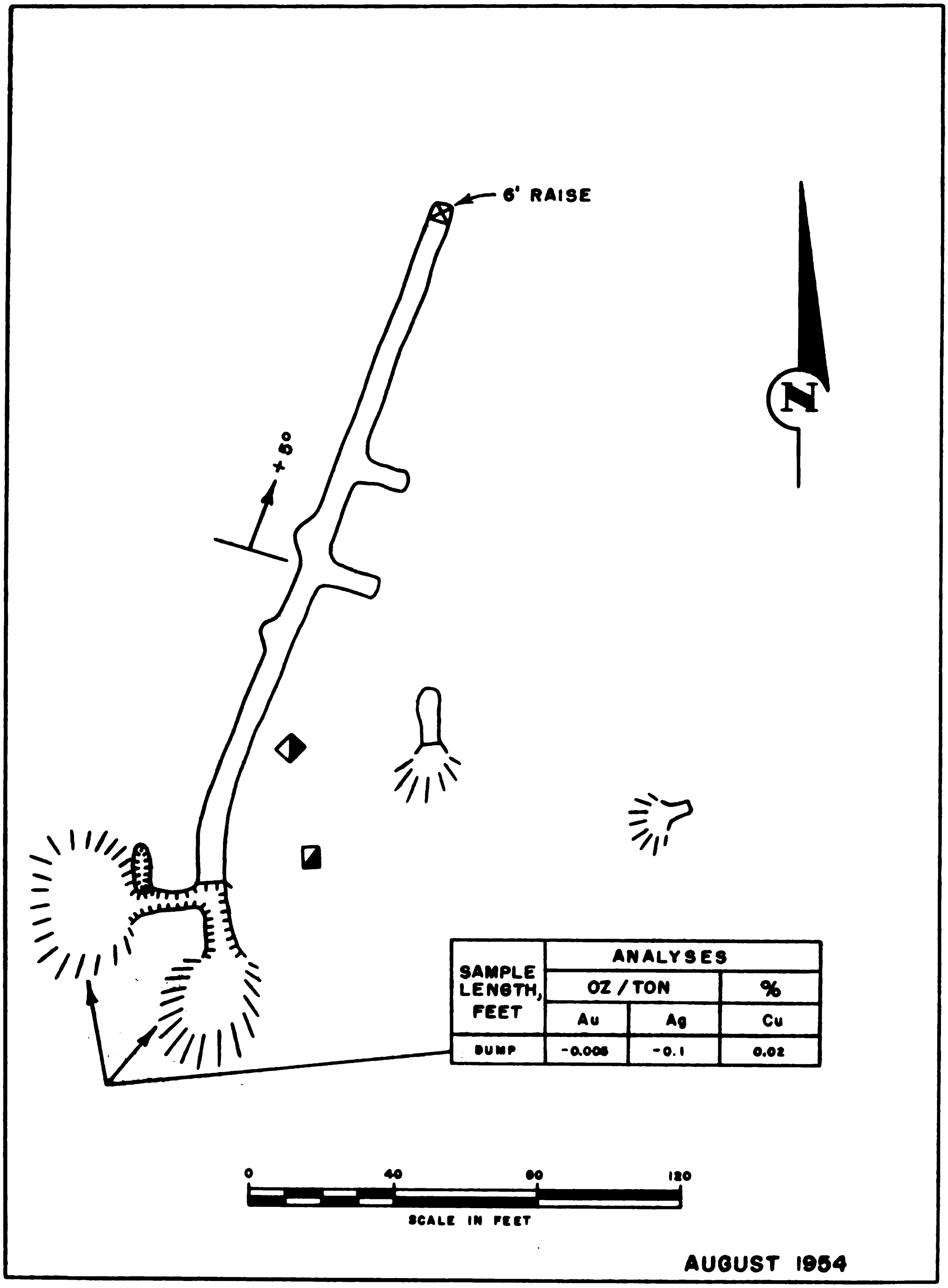
[2] Harley, G. T., The Geology and Ore Deposits of Northeastern New Mexico: New Mexico Sch. Mines and State Bureau of Mines and Mineral Resources Bull. 15, 1940, p. 38.



SAMPLE LENGTH, FEET	ANALYSES		
	OZ / TON		%
	Au	Ag	Cu
DUMP	-0.005	-0.1	0.02

Figure 9. - Sketch of workings on unnamed deposit, North Cimarron area.

The dump showed that most of the work was done in iron-stained rock. The iron minerals may have been derived from waters ascending from depth. If it can be established that there is a relationship between the iron and copper nearby, the question of the derivation of the copper minerals might be solved. The copper deposits are similar to those north of the Cimarron River and those in southeastern Colorado a few miles farther north. However, the mineralization seems more disseminated and malachite is the predominant copper mineral.

Peacock Canyon Deposits

About 11 airline miles west or 18 miles by road from the Fort Pitt deposits is a group of deposits in Peacock Canyon (see fig. 10). These deposits are accessible by traveling west on New Mexico State Highway 325 for 20 miles from its junction with State Highway 18 (see fig. 8), then traveling south over a ranch road 4 to 5 miles to the area of the deposits. This area is 41 miles by road east of Folsom, N. Mex., the nearest rail point. By coordinates, the area of the deposits lies in secs. 7, 18, and 19, T. 31 N., R. 34 E., and secs. 13, 24, and 25, T. 31 N., R. 33 E.

Activity began in 1900, when the Limited, Yellow Bird, Monarch, Gray Eagle, White Dove, Copper Glance, Peacock, and other claims were located; it probably was short lived.

The copper mineralization occurs, seemingly associated with small steep faults, in a generally flat-lying sandstone member of the Dockum group of Triassic age. Mineralization is spotty and occurs in the small fault zones as well as in patches and disseminations in the adjoining sandstone. Although small areas of fair-grade copper mineralization occur, the general overall grade is extremely low. One dump sample near a shaft down a small fault contained 1.17 percent copper, a trace of bold, and 0.3 ounce of silver per ton. This was one of the better appearing deposits and is situated in the SW1/4 sec. 13, T. 31 N., R. 33 E.

One noteworthy characteristic in the areas of copper mineralization was the complete bleaching of the Dockum (Santa Rosa?) sandstone from its characteristic red color to nearly white. The areas of bleaching are small in extent. If there is a relationship, as seems likely, between the bleaching and the copper mineralization, the areas of mineralization likewise are small. Malachite and azurite were the observed copper minerals.

Other Deposits in Union County

Small amounts of copper minerals have been reported in Union County in the Cimarron River Valley and about 20 miles west of the Peacock Canyon deposits. According to Harley,[3] malachite and azurite stains occur in rocks of the Dockum group of Triassic age. Small nodules of chalcocite coated with malachite were found in a gray sandstone bed. Prospecting was limited to shallow workings.

Mining claims were located in sec. 25, T. 6 N., R. 1 W., in sec. 1, T. 31 N., R. 37 E., in sec. 2, T. 30 N., R. 30 E., and in sec. 8, T. 30 N., R. 29 E. The first two locations are in Oklahoma and do not exist in Union County, and no mine workings were found in the last two.

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[3] Work cited in footnote 2, p. 36.

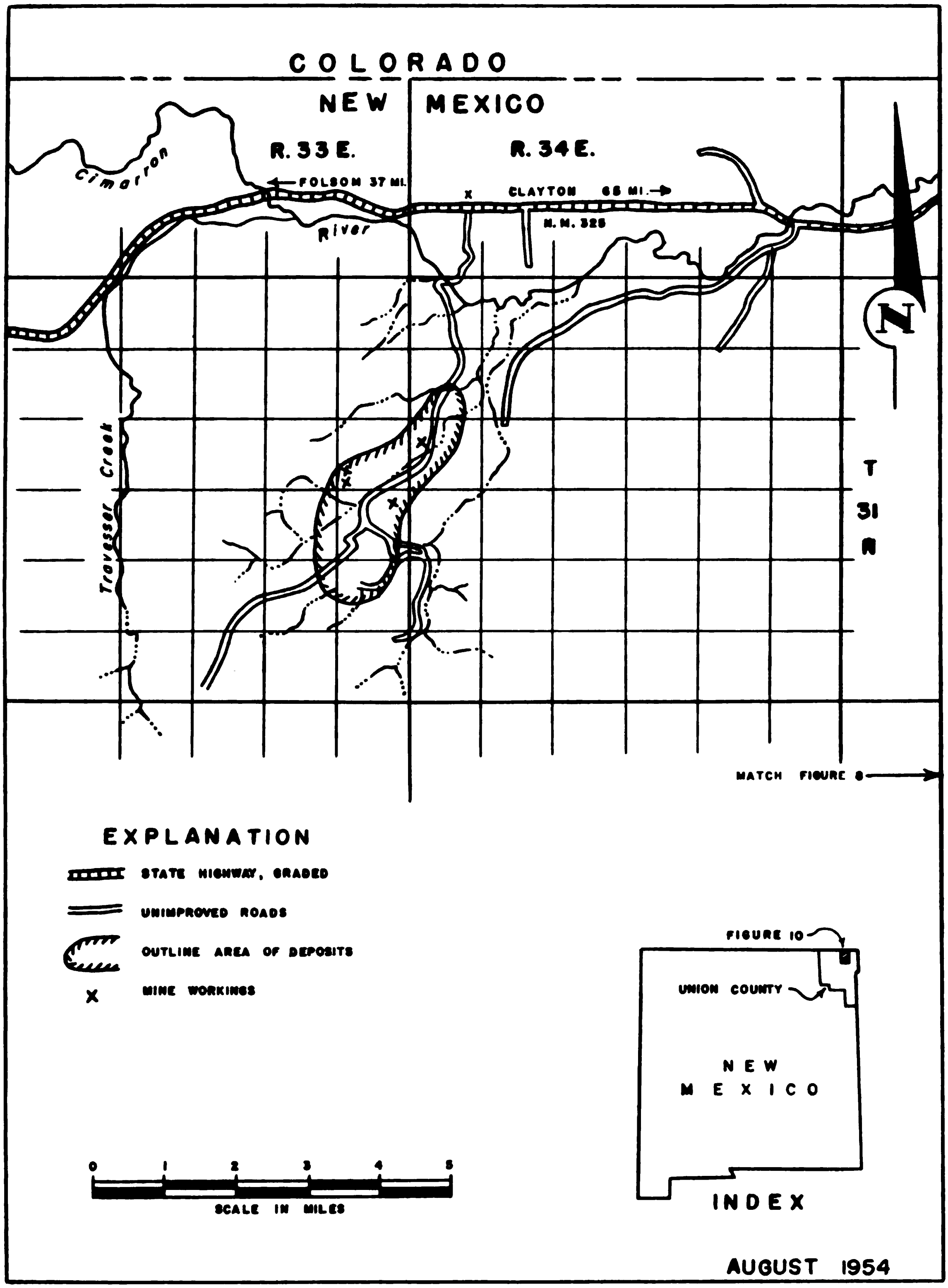

Figure 10. - Peacock Canyon area, N. Mex.

Deposits in Harding County

"Red Bed" copper deposits were reported in Harding County south of Gallegos.[4] Since the above notation, the county boundaries were relocated, and the deposits now are in Quay County and are described in the next section.

Deposits in Quay County

There are a number of "Red Bed" copper deposits in Quay County. As mentioned in the preceding paragraph, deposits now in Quay County were once in Harding County. According to Harley,[5]

> .... south of Gallegos, the Triassic rocks at the base of the Canadian Escarpment contain deposits of copper minerals, which are found in a bed of bluish-gray sandstone. Chalcocite has evidently replaced the cementing material between the grains of the sandstone; at times the mineralizing action was so intense as to include replacement of the grains themselves and the development of nugget-like masses of chalcocite lying across the structure of the sandstone. Very few plant remnants were visible in hand specimens, and those that were seen appeared not to be replaced by copper. Chalcocite has nearly everywhere been altered to malachite which forms a shell around a residual core of chalcocite.
>
> Although the copper-bearing rocks are exposed over a distance of 5 or 6 miles along the base of the Canadian Escarpment in this locality the impression was gathered that the mineralization is weak and irregular and that the probability of developing ore in commercial quantities is negligible.

Deposits West of Logan

South of the above deposits and near the junction of Ute Creek and the Canadian River, some mining activity from 1910 to 1920 was evident from county records. Since 1920, there was virtually no activity until recently, when many claims were being staked in a hunt for uranium minerals.

Deposits occur about 8 miles west of Logan, N. Mex., and the claims Gold Ridge, Camp Bird, Wisconsin, Tiger, Blue Granet, Evening Star, Copper King, Copper Ridge, and Combination were located. The above claims were located in secs. 11, 12, 24, and 25, T. 13 N., R. 32 E., as shown on figure 11. Mineralization occurs as malachite and azurite with some remnant chalcocite in a shaly sandstone of the Dockum formation of Triassic age. Prospecting was limited to shallow pits. Mineralization is weak and scattered.

Mineralization is reported[6] farther to the west up the Canadian River and is presumed to be similar.

About 2 miles southeast of Logan in secs, 24 and 25, T. 13 N., R. 33 E., the High Peak claims were located in 1911. No mine workings nor copper deposits were found in this area.

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[4] Work cited in footnote 2, p. 46.
[5] Work cited in footnote 2, p. 46.
[6] See work cited in footnote 2, p. 67.

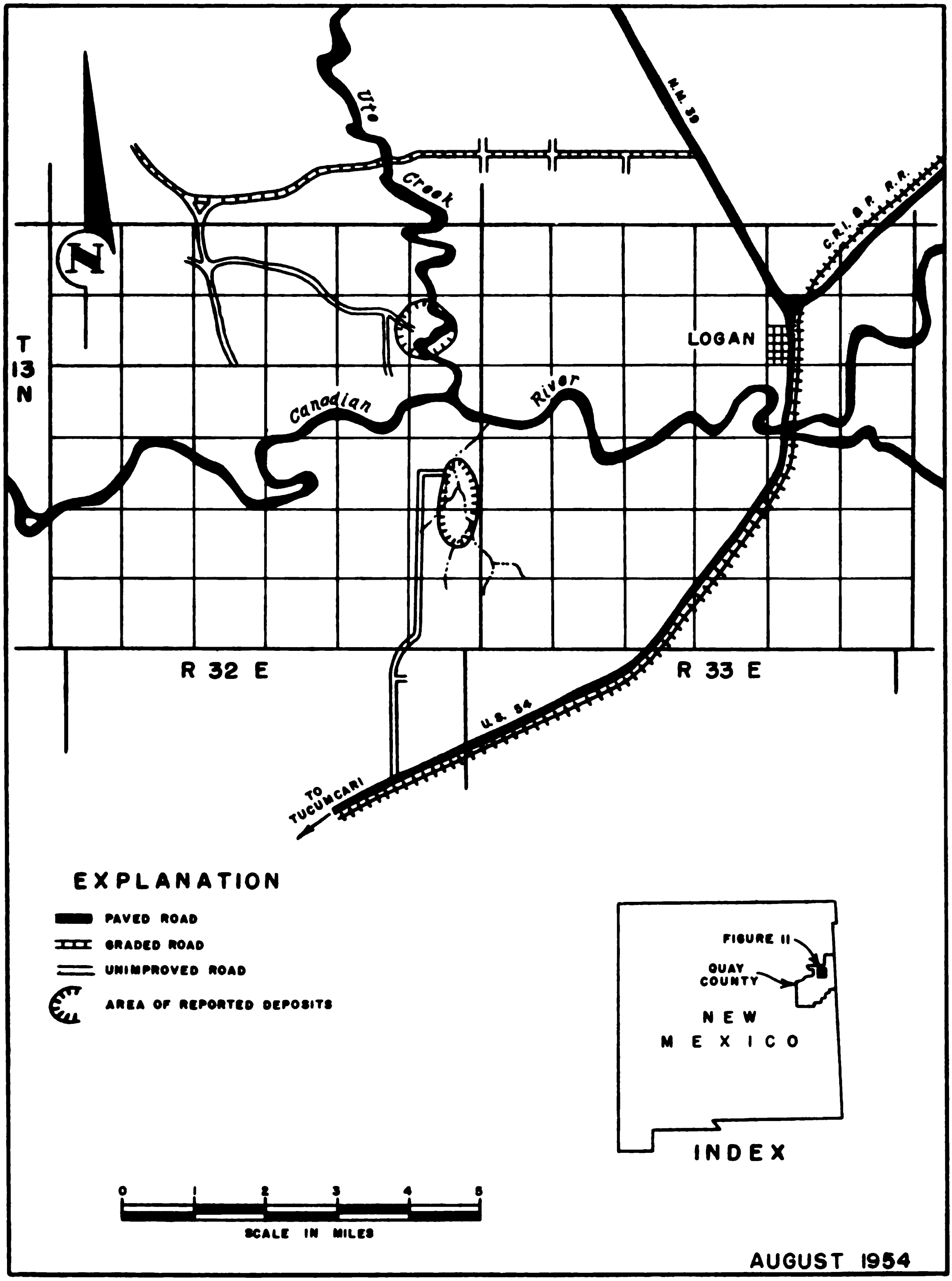

Figure 11. - Deposits west of Logan.

Deposits Near the Llano Estacado

In an area about 20 miles southeast of Tucumcari considerable prospecting took place around 1910, and continued intermittently until 1919. Claims were located in secs. 22, 23, 24, 28, 29, and 33, T. 9 N., R. 33 E., and sec. 18, T. 9 N., R. 34 E., as shown on figure 12. This is along the escarpment of the Llano Estacado (Staked Plains) where the Mesozoic sedimentary rocks are well exposed.

In 1919, the Red Peak Copper Co. did some work in the SW1/4 sec. 28, T. 9 N., R. 33 E. The formation is the Triassic Dockum group, and certain flat-lying beds have been silicified to quartzite. The silicification seems of small areal extent. Nearby beds were bleached and mineralized with a small amount of pyrite. No copper minerals were seen, and a dump sample, when analyzed, contained 0.03 percent copper and virtually no gold or silver.

Mine workings consisted of an inaccessible adit of unknown extent. It probably was less than 100 feet long.

A few miles east in Grapevine Canyon some prospecting was done. Here certain beds of the Dockum formation are patchily impregnated with limonite and a little hematite. No copper minerals were seen.

Mining claims were located in sec. 24, T. 8 N., R. 32 E., but no areas of mineralization or mine workings were found.

Deposits in Guadalupe County

There are two important "Red Bed" copper deposits in Guadalupe County. These are about 5 miles apart and a few miles west and southwest of Santa Rosa, N. Mex., the county seat. The deposits are known as the Guadalupe and the Pintada lodes. County production probably exceeded 250,000 tons of ore, from which more than 12,004,437 pounds of copper has been recovered.

The Guadalupe Deposit

The Guadalupe deposit was worked as the Stauber mine and the adjoining D'Autremont or Pastura Copper Co. mine. Both are near the center of the S1/2 sec. 6, T. 7 N., R. 20 E., as shown on figure 13. The area is reached by traveling southwest on U. S. Highway 54 for 13.4 miles from Santa Rosa, thence turning right and traveling west and northwest 3.7 miles to the mines.

The Guadalupe mine was discovered before 1918. A small shipment was made from the discovery, which was not profitable.7/ In 1925, I. J. Stauber acquired the property and began an operation that lasted into 1930. About the same time an adjacent property was acquired by the D'Autremont interests, and a small shipment of ore was made. From 1931 to the early 1940's the district was idle. In 1941 the Guadalupe Mining Co. leased the Stauber property and began operations. Also, a little later, the D'Autremont interests, the Pastura Copper Co., returned and mined out their part of the ore body. The Guadalupe Mining Co. operated only a short time, and in the late 1940's the Stauber mine was acquired by Drunzer and Casner, who have operated the property intermittently to the present time. Operations were being continued in mid-1954.

7/ Holmquist, R. J., Stauber Copper Mine: Bureau of Mines Rept. of Investigations 4026, 1947, 7 pp.

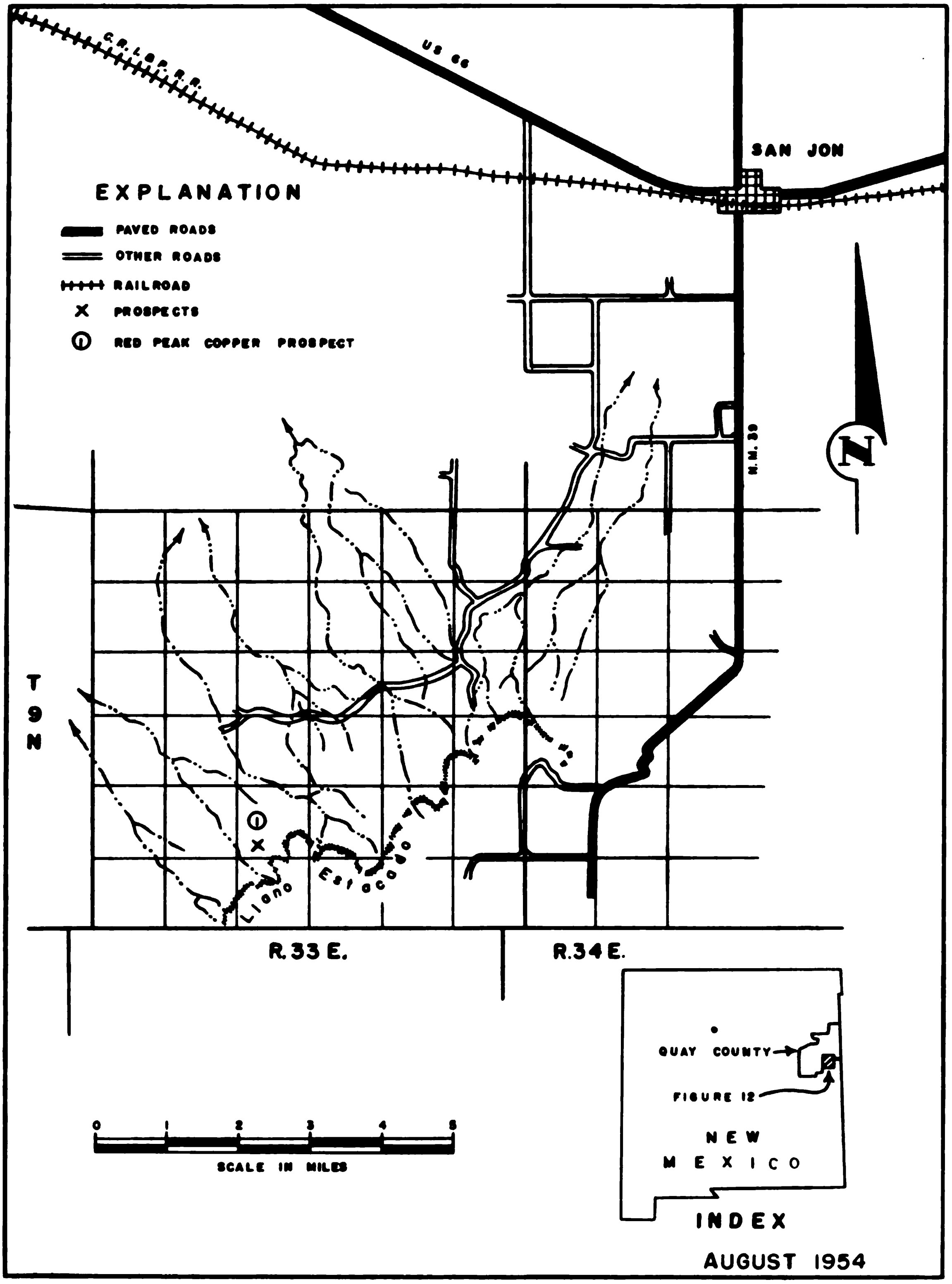

Figure 12. - Deposits near Llano Estacado.

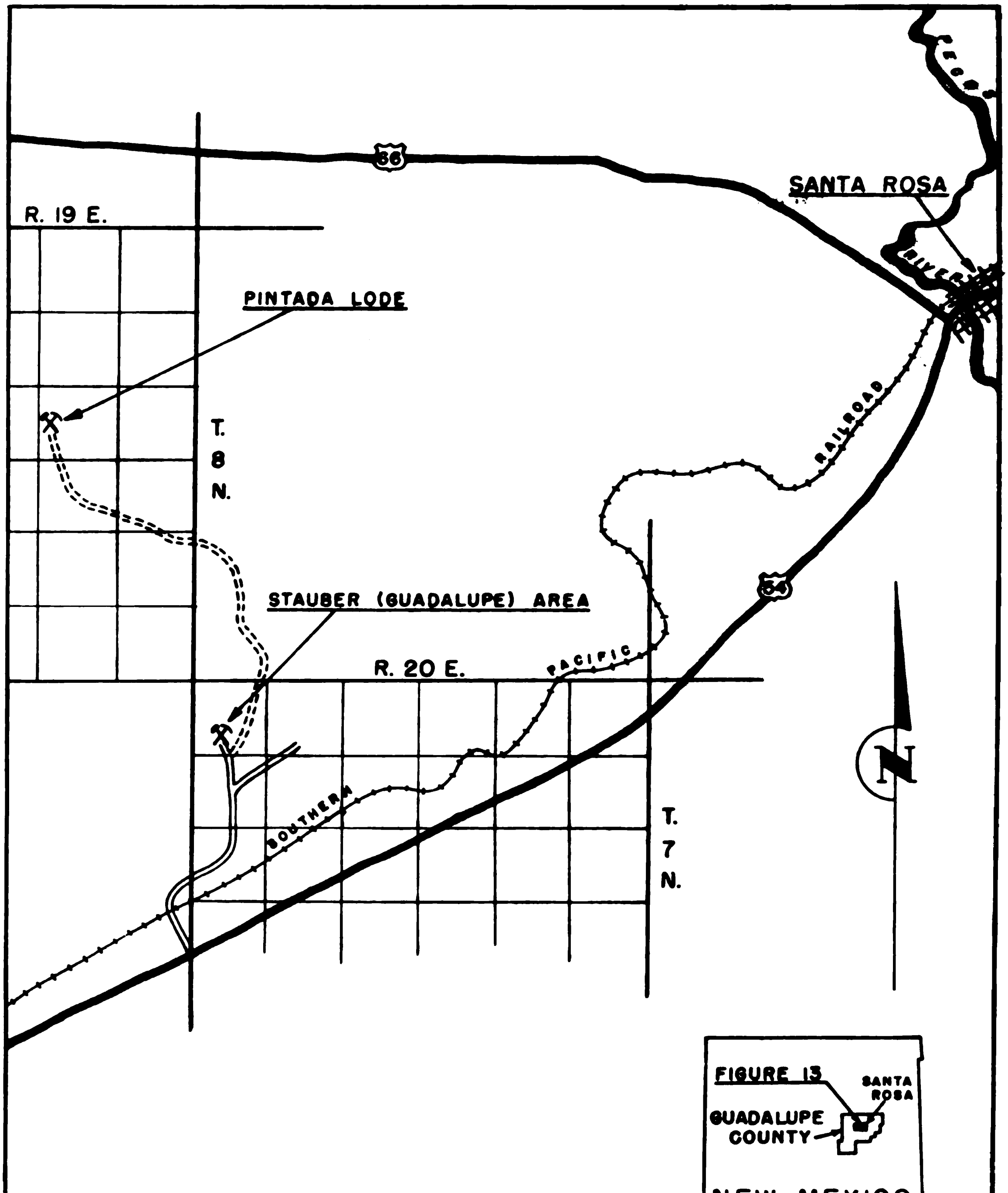

Figure 13. - Location map, Guadalupe County deposits.

The first mining at the Stauber mine was a room-and-pillar method using hand tools. Because the ore body is flat and the amount of overburden small, entry was made by shallow shafts. Later a more systematic room-and-pillar method with a common entry was used. Some pillars were reclaimed upon retreating. A small amount of open-pit work was done near the outcrops. When the Guadalupe Mining Co. began to work the mine, open-pit methods were used entirely, and many pillars were reclaimed by stripping the overburden and mining the pillars. New ore also was mined by this method. All operations of the Pastura Copper Co. used open-pit methods. Drunzer and Casner continued mining ore by open-pit methods until early 1954, when the overburden ratio became too large. Underground mining was reverted to, and the ore faces were entered from the pit and the pit equipment adapted to the underground work. Figure 14 shows the mine as it was in 1942, and the present pit outlines are sketched upon the old stoped areas.

Present mining is being done with "jackleg" type of rock drill, and the rounds are electrically blasted. A tractor-type loader is used to load the ore into a trailer, which is then hauled by the tractor to a nearby ore bin. Trucks take the ore from the bin to the railroad siding, about 2 miles. The rail haul to the smelter at El Paso, Tex., is about 260 miles.

The grade of the ore has varied from a little over 5 percent during early operations to a little over 1 percent for later shipments. In April 1954, the grade of the ore was over 2 percent. The ore is highly siliceous and commands preferential smelting rates because of this quality. However, the quantity of this ore that can be used by the smelter is limited.

The district has been studied by various individuals and agencies. The Federal Geological Survey studied and mapped the deposits in 1943 and the Federal Bureau of Mines did considerable development work the same year. The Bureau excavated 229.5 linear feet of test pits in 11 pits in an attempt to extend the known ore reserves. Some metallurgical testing also was done by the Bureau. The above work is reported in a Report of Investigations.[8]

The copper mineralization occurs in the generally flat lying Santa Rosa sandstone member at the base of the Dockum formation of Triassic age. A relatively impervious bed of shaly clay underlies the sandstone and overlies the gypsiferous Chupadera formation of Permian age. A shale or sandy shale overlies the ore-bearing sandstone.

The mineralized bed exhibits a slight troughing with irregular tongues stemming from the main mass. The troughing, whether by compaction or slight slumpage of the underlying beds, trends northeast. The sandstone in the ore area is fractured and jointed. Crossbedding was noted.

The ore minerals are malachite, with some azurite and a little copper pitch. Some chalcocite is present with scant amounts of other sulfides. Replacement of carbonaceous material seems unimportant, although it was noted. It seens evident that chalcocite was the primary copper mineral, and where seen it has halos of malachite. The mineralized bed is 2 to 17 feet thick.

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[8] See work cited in footnote 7.

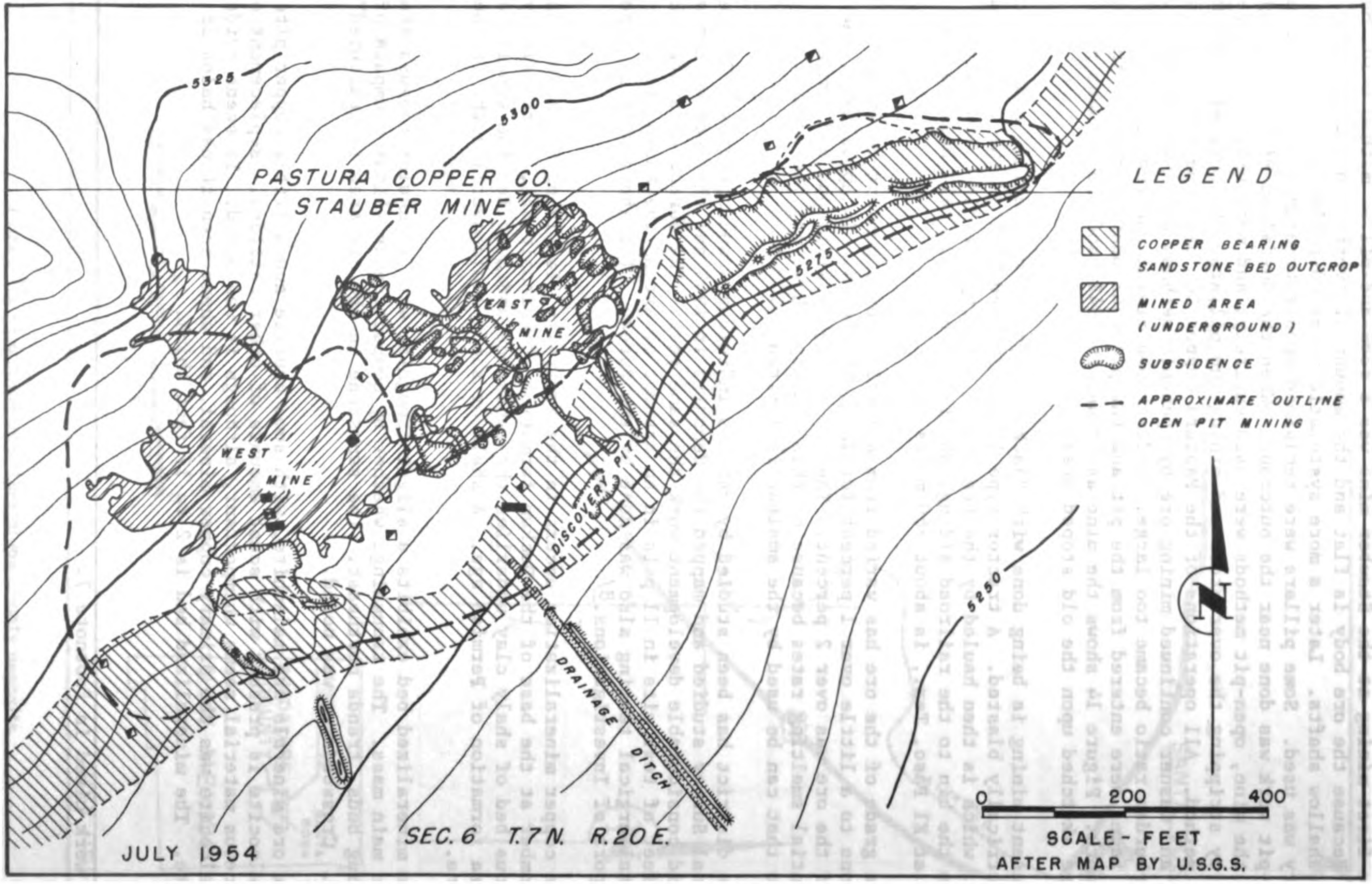

Figure 14. - Map of the Stauber mine.

Pintade Lodes Deposit

This deposit is 6 miles by road north and a little west of the Stauber mine. It is situated in the W1/2 sec. 14, T. 8 N., R. 19 E., as shown on figure 13. The area is best reached by going to the Stauber mine, skirting the east side of the mine workings and continuing north on a dirt road, then following this road, and keeping to the left, for 6 miles. The Pintade lodes are just a short distance north of Pintada Creek. The small hamlet of San Ignacio is about 3 miles west of the deposits.

The Pintada-lode deposits have been known for many years and interest has been shown in them many times. Past attempts were made to treat the ores locally, but all attempts were short lived. Production probably has not exceeded a few carlots of ore, most of which was recently mined and shipped by Drunzer and Casner to El Paso smelters. The last shipments were acceptable at the smelter as a suitable fluxing ore according to reports.[9]

The copper mineralization occurs in fine-grained, flat-lying sandstone members of the Chupadera formation of Permian age. Gypsum beds abound in the formation. No carbonaceous material was noted. Chalcocite was the primary copper mineral and occurred in patches and streaks of small dimensions. Some malachite was observed along bedding planes as patches and as a dissemination throughout the sandstone. As exposed, a bed about 4 feet thick contains the bulk of the copper minerals, whereas low-grade material may exceed this thickness by 2 or 3 times.

A Bureau of Mines engineer[10] took samples of the deposit. The sample results are shown in the following tabulation:

TABLE 3. - Sampling of Pintada lodes

Sample interval, feet	Length, feet	Copper, percent	Remarks
		0.12	Dump; pit 750 feet southwest of open pit.
		.16	Dump; pit 70 feet west of above.
		.11	Specimen west outcrop.
13.0 - 16.1	3.1	.20	Pit 750 feet west of open pit.
6.6 - 7.6	1.0	.07	Pit above.
	6.0	.12	East outcrop, upper bed near open pit.
	4.0	1.87	East outcrop, second bed near open pit.
	4.0	2.24	East outcrop, third bed near open pit.
	2.6	2.05	East outcrop, lower bed near open pit.
		1.99	Dump grab of stockpile.
	3.7	.66	Lower bed, 70 feet southeast of pit.
	3.0	.39	Third bed, 330 feet southeast of pit.
	2.5	.93	Second bed near above.
	1.6	.66	Third bed 230 feet northwest of open pit.

The outcrop was broken down into four units in the above sampling. The open pit where the best appearing ore was mined is the center of the area and sample directions were based on this point. One sample, a general grab of the material exposed in the open pit, was taken by the author. This sample contained 2.47 percent copper, 0.2 ounce of silver, and less than 0.005 ounce of gold per ton.

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[9] Drunzer, Q. oral statement.

[10] Holmquist, R. J. 1943.

Development work consisted of several scattered shallow pits done for location and assessment work and the main open pit, which was about 75 feet long and 50 wide at its widest point. The pit is less than 20 feet deep from the small mesa rim to the southwest.

In 1943 a metallurgical sample was sent to the Bureau of Mines laboratories at Rolla, Mo., for testing. This sample contained 2.5 percent copper; 80 percent of this copper was nonsulfide. About 64 percent of the copper was recovered in a flotation concentrate, and about 64 percent of the copper remaining in the tailings was recovered by leaching with acid. The acid consumption was high.

Other Deposits

Old residents of the State told the author of copper deposits near Anton Chico, about 20 miles northwest of the Pintada lodes. A visit to the district failed to disclose any copper deposits.

Deposits in Mora County

Beginning a little south of east of Guadalupita and continuing down Coyote Creek for about 7.5 miles is a series of small deposits occurring in steeply tilted arkose and shale beds. In 1917 a small quantity of 8.5-percent copper ore was mined and shipped from the John Hays mine at the northern end of the district. These occurrences are situated in secs. 14, 22, 23, 27, and 34, T. 22 N., R. 16 E. Mine workings continued south into the next township, but copper minerals were rare. (See fig. 15.) The above township is unsurveyed, and the above sections were projected from surveyed townships.

The property is reached by going to Mora, N. Mex., 28 miles north of Las Vegas, thence 15 miles north to Guadalupita, N. Mex. The deposits are east and south of Guadalupita and parallel to Coyote Creek, as shown on figure 15. The nearest rail point is Las Vegas, 36 miles south by nearest road. The road from Mora to Las Vegas is paved.

The copper mineralization is confined to certain beds in 3 or possibly 4 stratigraphic horizons of the Permian Abo (?) formation. The beds have steep dips east or west. This suggests intense folding, faulting, or both, as the sedimentary series 1 mile or so eastward are relatively undisturbed. The strike of the tilted beds is southward, paralleling Coyote Creek and the road. The deposits occur just west of the road, except in the northernmost part of the area, where the outcrops cross Coyote Creek.

The copper minerals chalcocite, malachite, and azurite, the latter two probably derived from the first, occur in arkoses and shales. Both of these rocks are highly micaceous in places. Mineralization occurs in patches, disseminations, and as nodules in the enclosing rock. Zones of mineralization are small, rarely as much as 100 feet along the outcrop or as much as 5 feet thick. Three samples were taken of the mineralized outcrop just south of the point where it is traversed by Coyote Creek. The analytical results are tabulated as follows. The samples represent a 4.6-foot cut across the outcrop.

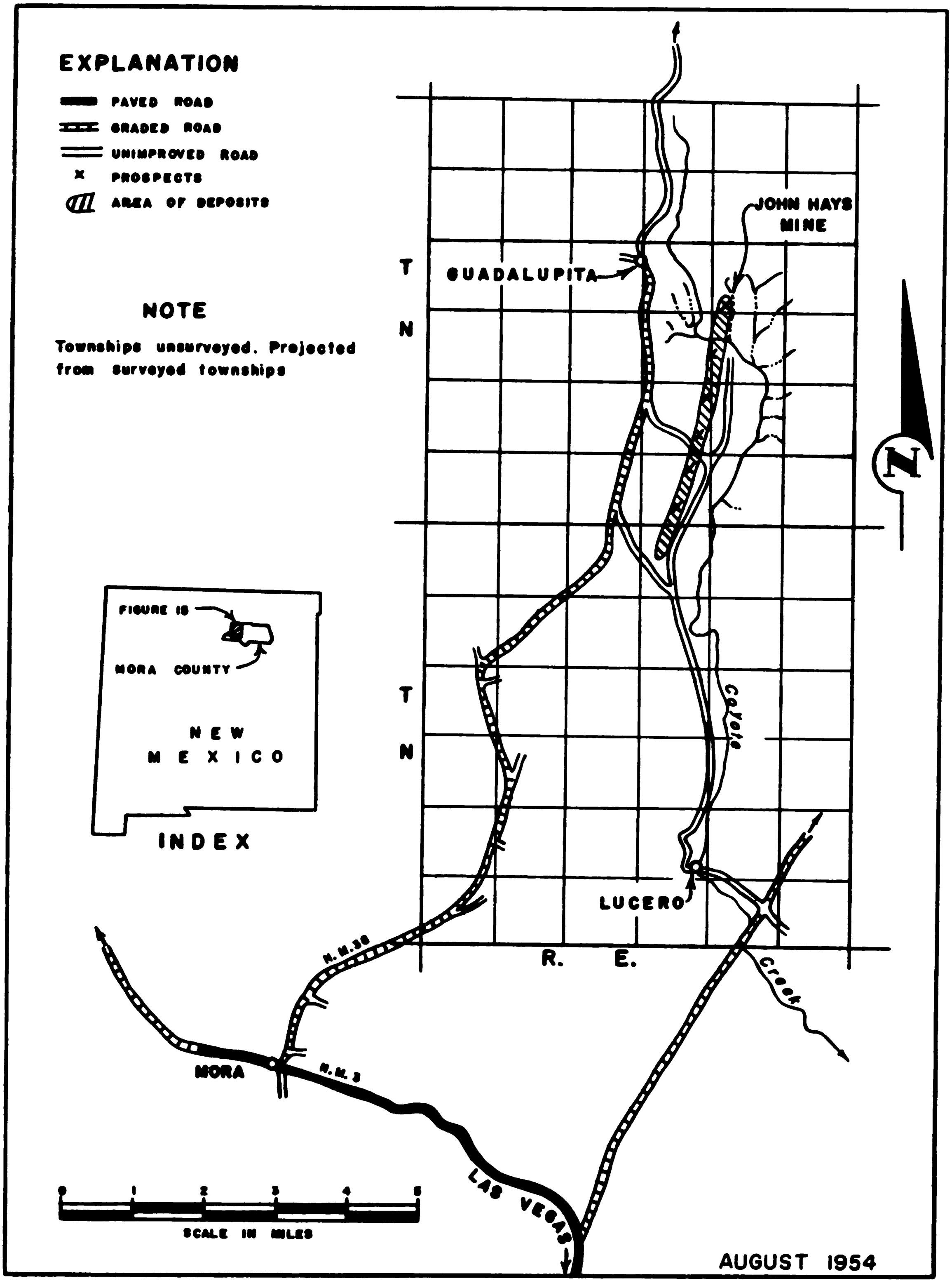

Figure 15. - Guadalupita (Coyote Creek) area, N. Mex.

TABLE 4. - Sampling of the Guadalupita deposits

Sample length, feet	Analyses		
	Oz per ton		Cu, percent
	Au	Ag	
1.0	0	0.02	0.15
2.4	0	.04	.23
1.2	0	.08	.50

A fourth sample was taken across 2.5 feet of the outcrop of dark micaceous shale at the collar of the John Hays shaft. This sample contained 0.44 ounce of silver per ton, 4.17 percent copper, and no gold. The writer took 1 sample of a dark shaly arkose from a dump about 3 miles south of the John Hays mine and a few feet west of the road. This sample contained 0.26 percent copper and virtually no gold nor silver.

There are many prospect pits along the zone of outcrops; and most are shallow, probably not exceeding 30 feet. Some deeper adits were noted to the south. At the northernmost end of the area the greatest amount of work was done. This was at the John Hays mine, where the shaft reportedly was 150 feet deep. A 30-foot drift extended from the shaft at an unknown location. The small district production reportedly was obtained from this mine. Scant amounts of copper minerals, usually malachite, were noted as thin coatings in fractures on an adit dump as far as 7.5 miles south of the John Hays mine.

Deposits in Santa Fe County

Two areas of "Red Bed" copper deposits are known in Santa Fe County. These are the Paytiamo and an unnamed group of deposits north of Glorieta, N. Mex. Glorieta is a point on the Santa Fe Railroad.

The Paytiamo Deposit

The Paytiamo copper prospect is in sec. 32, T. 16 N., R. 11 E., about 2 miles west and a little south of Glorieta, N. Mex. (See fig. 16.) It is about 1,500 feet north of U. S. Highway 85. According to Holmquist, scant copper minerals are found in Permian sandstones. One streak of high-grade material measuring 4 feet long and 1 inch wide was sampled and contained 5.6 percent copper. Some float was noted in some of the creeks. Malachite and tenorite were the copper minerals noted, and intrusive rocks were noted near the areas of the copper mineralization.

Kunklin (?) Deposit

An unnamed deposit is about 2.5 miles north of Glorieta. It is in the area of the Kunklin deposits mentioned by Lindgren,[11] and is not easily accessible. It is situated in or near sec. 15, T. 16 N., R. 11 E. (See fig. 16.) It may be reached by going southeast on U. S. Highway 85 alternate (the north branch) for 1.8 miles from Glorieta, then north over the Baldy Lookout road for 4.0 miles or 0.7 mile beyond a cattle guard. Here a dim road turns off the left, and this is followed for about 1 mile west to the prospect at its end. Most of this road is passable only to vehicles with 4-wheel drive and then only with difficulty.

11/ Lindgren, Waldemar, Graton, L. C., and Gordon, C. H., The Ore Deposits of New Mexico: Geol. Survey Prof. Paper 68, 1910, p. 112.

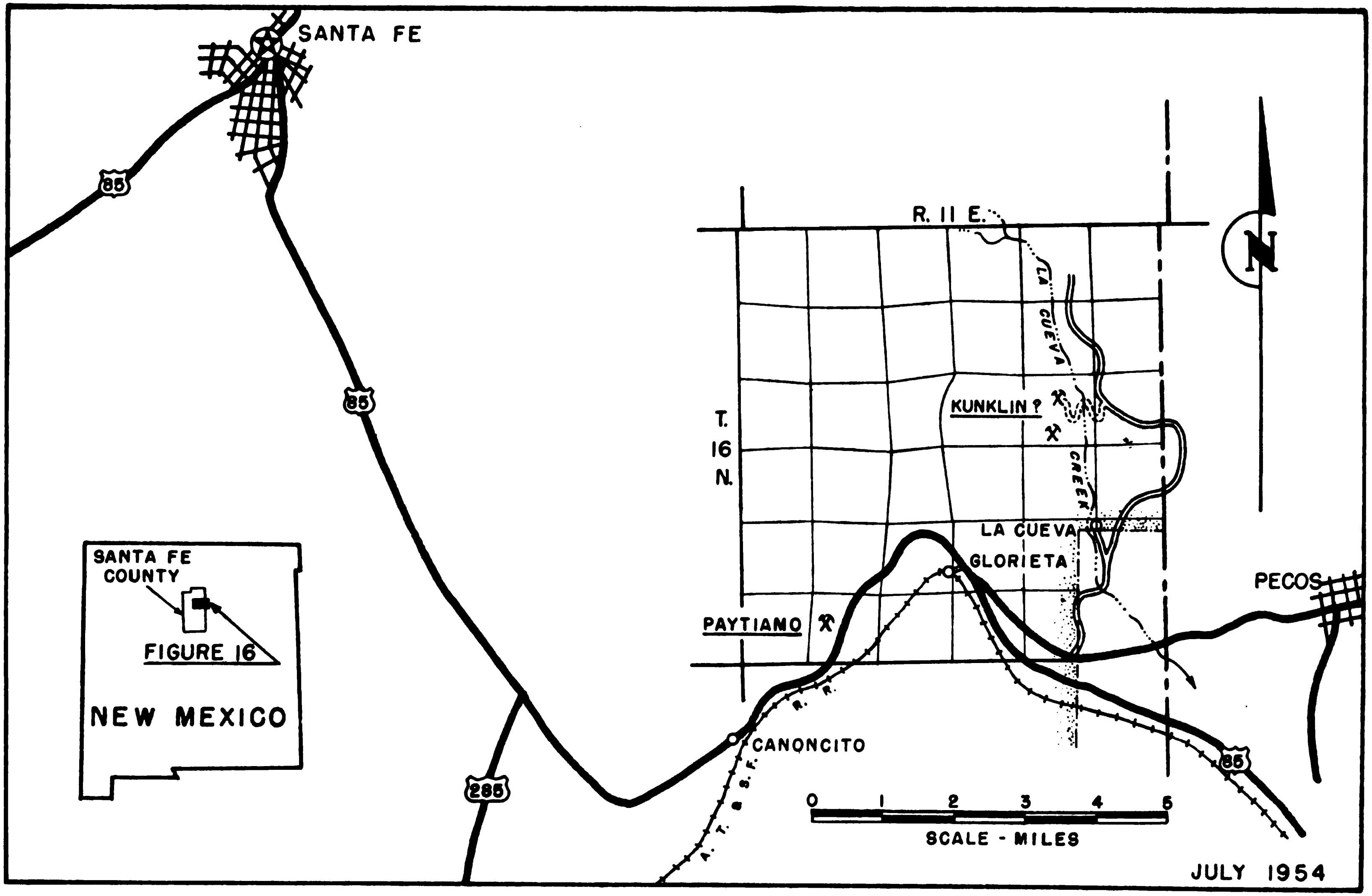

Figure 16. - Location map, Paytiamo and Kunklin deposits.

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Copper mineralization occurs in a grit or very coarse arkose bed in the Abo formation of Permian age. The beds dip gently westward. As developed by two adits shown on figure 17, the mineralized bed is about 5 feet thick, 50 feet wide, and 20 feet deep. Extensions of these dimensions are possible, although mineralization in the outcrop cannot be traced beyond the talus that obscures the outcrop in the vicinity of the mine workings. One cut sample taken at the portal of the deepest adit contained 3.26 percent copper, no gold, and 0.6 ounce of silver per ton.

This property shows signs that fairly recent attempts were made to operate it. The mine is equipped with a small compressor, and a crude tramway was constructed to lower the ore to the end of the road. This tramway may handle as much as 50 pounds of ore per trip of approximately 150 feet. Any production from this prospect has been negligible.

Other similar occurrences exist to the south toward Glorieta; and about 1 mile to the south and in the bottom of La Cueva Creek, copper mineralization was reported in limestone.[12]

Deposits in Bernalillo County

The total production of copper from Bernalillo County has been small - 31 tons of the metal. Most, if not all, of this may have been derived from "Red Bed" copper deposits. One deposit, not strictly a "Red Bed" copper, is in or near the NW1/4 sec. 26, T. 10 N., R. 5 E. This is a little less than 1 airline mile of the village of Tijeras, N. Mex. Tijeras is about 19 miles east of Albuquerque and is on U. S. Highway 66. The property is reached by going south from Tijeras on State Highway 10 for 1.4 miles, turning to the left, and following a dirt road east for 0.2 mile. The property lies on top of small hill just north of the dirt road and was located as the Santo Domingo in 1942 and the P & G claims in 1951.

The copper minerals occur in the Magdalena formation of Pennsylvanian age and are associated with a strong north-trending fault. The fault dips steeply westward at about 85°. Chalcocite, malachite, and azurite were the observed copper minerals, which occur in small stringers and some replacement of the limestone and sandstone wall rock. Most of the copper mineralization was in the limestone, but mineralized sandstone was noted on the dump. The general grade of the ore was low, but the grade could be raised appreciably by careful sorting.

The mine workings consisted of several shallow pits and a shaft about 25 feet deep. Additional mine workings were noted to the north as far as 2 miles and north of U. S. Highway 66. The northerly workings were in the Abo formation of Permian age.

Other deposits were reported about 15 miles north and a little east of the above deposits. They were not located.

Deposits in San Miguel County

"Red Bed" copper deposits occur in San Miguel County west of Las Vegas and extend from Rociada in the extreme northern part of the county to Sena in the south. Most were only prospects and the work on them was done about the turn of the century; they have been forgotten and are difficult to locate.

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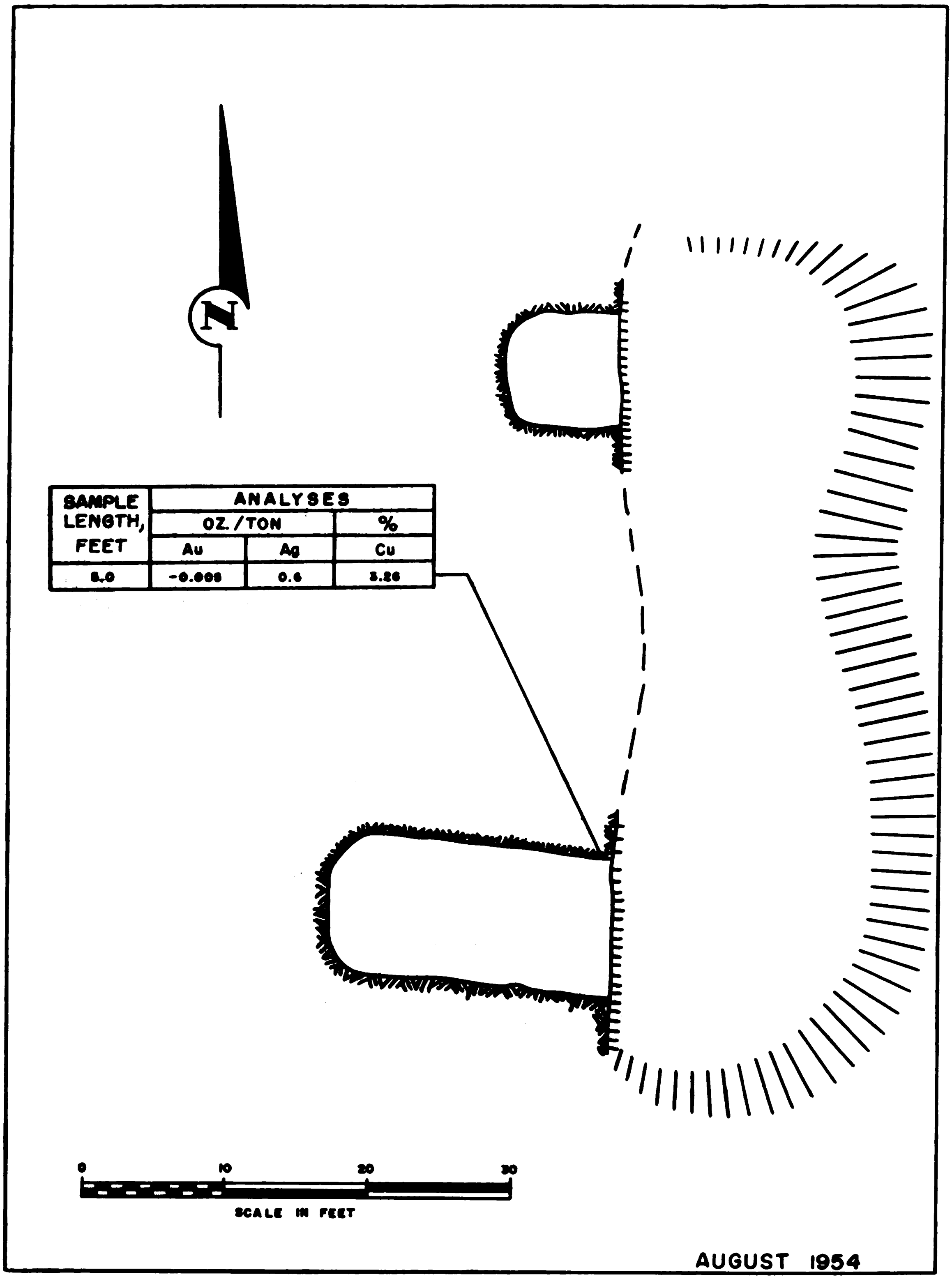
[12] See work cited in footnote 11, p. 112.



SAMPLE LENGTH, FEET	ANALYSES		
	OZ./TON		%
	Au	Ag	Cu
5.0	-0.005	0.6	3.26

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Figure 17. - Sketch assay plan, Kunklin (?) deposit, N. Mex.

In T. 16 N., R. 12 E., in the extreme western part of the county, Lindgren[13] reported the Kunklin deposits. These deposits probably are those examined in Santa Fe County and mentioned in the preceding section.

Deposit Near Rociada

In an arkosic sandstone-grit member of the Magdalena formation of Pennsylvanian age, "Red Bed" copper occurrences were reported[14] in an area just west and a little south of Rociada. No workings were found, and a description of the deposits is quoted from the above reference.

> A short distance southwest of the Joe and Jenny prospect (about 1/3 mile west of Rociada) several openings have been made in the carboniferous grit or coarse sandstone, which here rests flatly upon the gneissic granite. The grit contains disseminated copper - mostly as carbonate - although a little glance is present. Considerable excitement prevailed at the time these developments were made, but no production has resulted. The grade of the ore is probably too low to be profitable.

Deposit Near Montezuma

Just 10 miles west of Las Vegas on the El Porvenir road and west of Montezuma a small amount of copper occurs in a greenish shale underlying the Magdalena formation of Pennsylvanian age. This shale overlies the pre-Cambrian basement and fills the erosional depressions in the basement rock to form an even surface for the overlying sedimentary rocks. A short adit next to the road was the only noted work, and a sample of the shale contained 0.06 percent copper and virtually no gold nor silver.

Mineral Hill

At Mineral Hill, 25 miles by road west of Las Vegas, N. Mex., via El Porvenir, an occurrence of "Reb Bed" copper was reported but was not found.

The Tecolote Deposits

The Tecolote district is large in area and may be subdivided into 2 general areas, 1 west and south of Tecolote peak extending from Bernal up Bernal Creek for several miles and the second a few miles to the southwest, extending along the Pecos river between Ribera and Sena. These areas are shown on figure 18.

In the area along the Pecos River some prospecting was done in slightly copper stained Glorieta sandstone of Permian age. None of the deposits seemed to be promising.

Along Bernal Creek considerable sums were spent, and considerable work was done on three properties - the Blake, the Bonanza, and the Hammond. Except for the Hammond mine, it was difficult to correlate the names of the mines with workings. Even long-time residents of the area proved to be of little help in this regard.

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[13] See work cited in footnote 11, p. 112.
[14] See work cited in footnote 11, p. 115.

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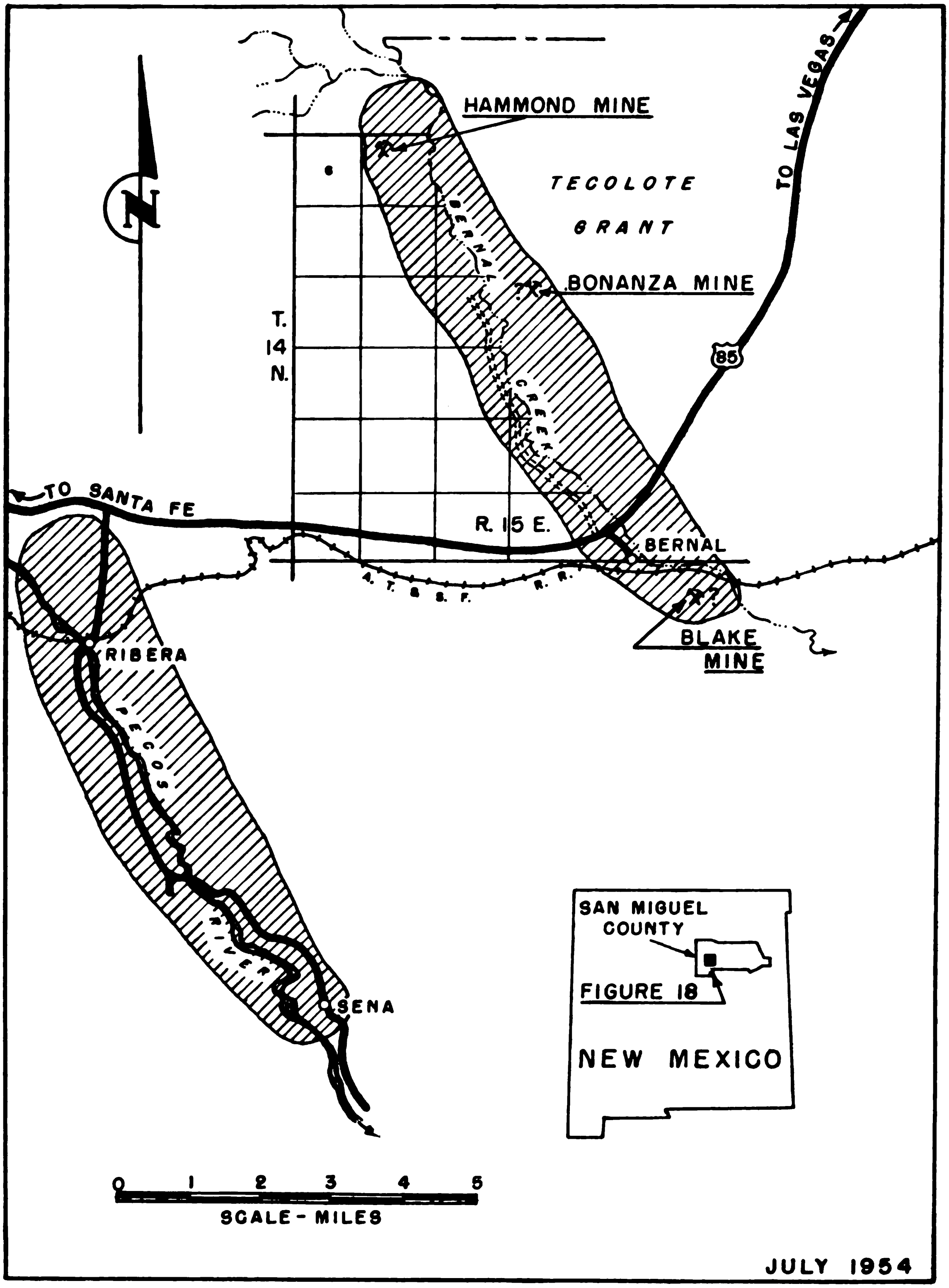

Figure 18. - Location map, Tecolote district.

Blake mine. - The Blake mine probably is near Bernal, N. Mex.,[15] but was not known to old-time residents of the area, who were questioned by the author. The mine was developed by a shallow inclined shaft and a small open pit. A leaching plant was installed and operated for a short while. This was in 1905, and 5,000 pounds of 70-percent cement copper was produced.[16] Probably no work has been done on the deposit since 1905.

According to the above reference, the copper minerals malachite and subordinate azurite occur in an arkose grit near the top of the Carboniferous. The beds dip 30° east-northeast and are about 8 feet thick at the mine openings. The ore is said to range from 1.5 to 5 percent copper. According to Harley,[17] the mineralized beds are arkoses belonging to the Magdalena formation of Pennsylvanian age.

Bonanza mine. - The Bonanza mine[18] probably is about 4 miles north from the Blake mine. The geology is similar, but the ore is more pocketed. A small leaching plant was erected. The same authority also mentions other small leaching plants in the area. Although the mine was not found, from the geology of the area it is suspected that the copper mineralization probably occurs at a much higher stratigraphic horizon than at the Blake mine, probably as high as the Glorieta sandstone of Permian age.

Hammond mine. - The Hammond mine is in sec. 5, T. 14 N., R. 15 E., just west of Bernal Creek and about 6 miles by poor road and trail northwest from Bernal, N. Mex. (see fig. 18). The road leaves U. S. Highway 85 just west of the Bernal post office. The post office is about one-half mile north of Bernal, a point on the Santa Fe Railroad.

Charles Hammond is reported to have located the property originally and to have spent about $18,000 in 1917 and 1918 in developing the property and installing a small treatment plant. The venture was short lived, and it seems that no work has been done since 1918.

Copper minerals occur in an arkosic sandstone member of Abo formation of Permian age. The beds dip east about 20°, and the mineralized part is 8 to 18 feet thick. The mineralization can be traced along the outcrop for about 500 feet, but such mineralization is not consistent.

Chalcocite was the primary copper mineral, and its oxidation product, malachite, was the predominant mineral. A small amount of azurite was noted, and sparse amounts of other copper sulfides may be present. The minerals occur as disseminations seemingly replacing the cementing material of the sandstone and also as nodules and patches. Carbonaceous material occurs in small amounts but was unimportant. The overall grade of material is very low, although a small amount of medium-grade material could be sorted from the mineralized rock. Two samples were taken at the outcrop at points about 200 feet apart, and they contained 0.10 and 0.76 percent copper.

The property was developed by a number of shallow pits and adits in close proximity to each other, as shown on figure 19.

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[15] See work cited in footnote 2, p. 60.
[16] See work cited in footnote 11, p. 117.
[17] See work cited in footnote 2, p. 60.
[18] See work cited in footnote 11, p. 120.

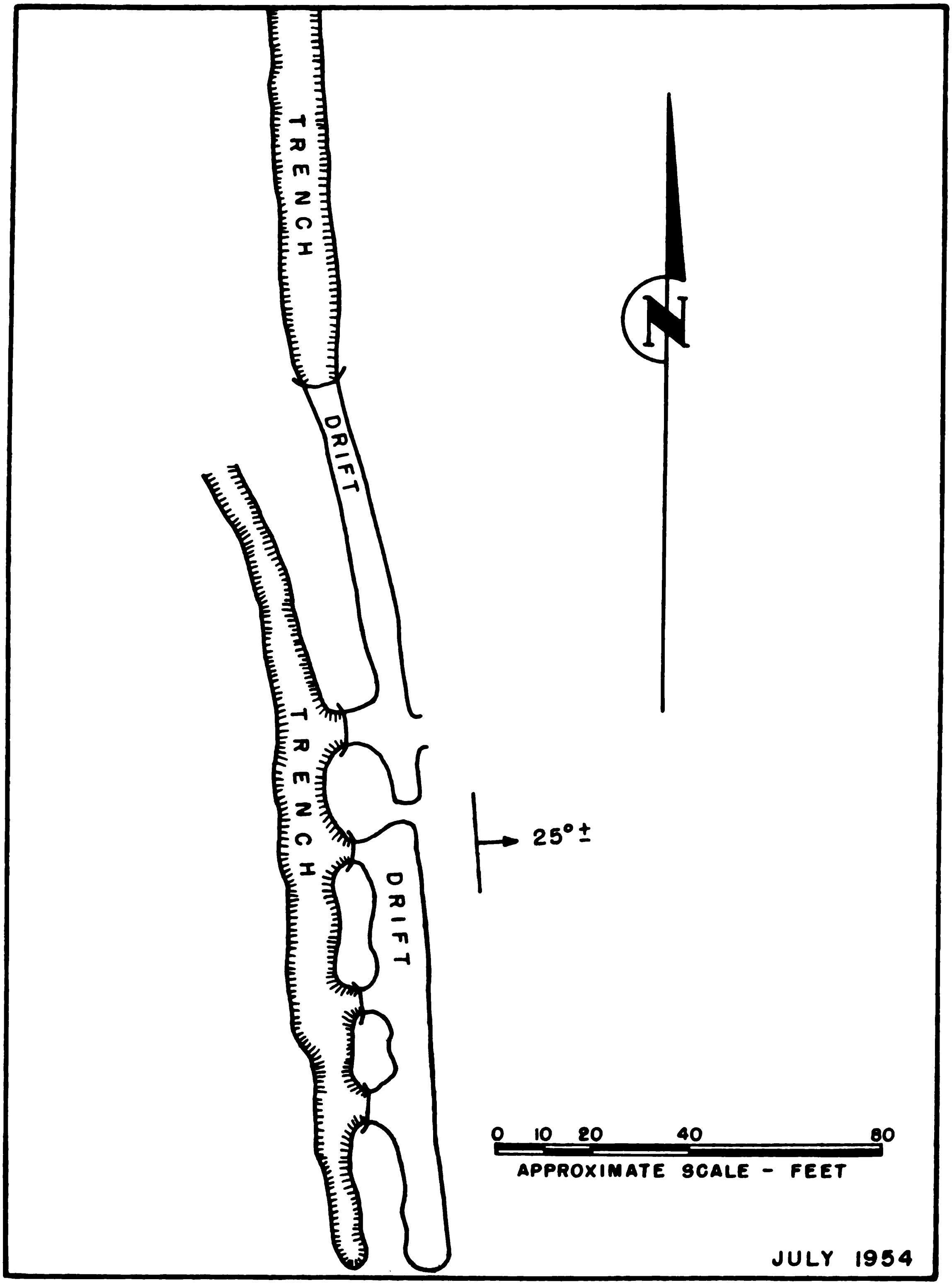

Figure 19. - Sketch of workings, Hammond mine.

Deposits in Valencia County

"Red Bed" copper deposits are known in the north central part of Valencia County in the Zuni Mountains (Copper Hill or Copperton) mining district. (See fig. 20.) Most of the deposits are situated in secs. 6 and 7, T. 11 N., R. 12 W., and are held by location by M. Mirabal of Grants, N. Mex. Early in 1954 seven unpatented claims comprised the group. The claims were Copperview, Sunshine, Hillside No. 15, Bluebell, Tam O'Shanter, Lone Star, and Boston. Small shipments of direct-smelting ore have been produced by intermittent operations since 1904.

In 1952 the Grants Mining and Leaching Trust leased the Mirabal mine, and about mid-1953 they applied to the Defense Minerals Exploration Administration for Government assistance to explore the deposits. Early in June 1954 this lessee was just completing a small ammonia leaching plant with which to treat the ores. It is sincerely hoped that the work is successful because, if so, it may revive interest in other similar deposits that have a difficult transportation and metallurgical problem to solve.

The Mirabal deposits are reached by going southwest on State Highway 53 for 0.5 mile from Grants, N. Mex., turning right and continuing on a dirt road for 10.1 miles, then taking a right fork for 0.8 mile, a left fork for 1.75 miles, and from there following the main road, well marked with signs, for 12.2 miles to a small cabin just to the left of the road. The route then turns left just past the cabin and follows this branch for 0.9 mile to the mines and mill. Many shallow workings are on the plateau crossed just before reaching the mill.

Copper mineralization occurs at the base of the Abo formation of Permian age. The Abo lies directly upon the pre-Cambrian basement of gneissic granite and is a thin mantle of sedimentary rocks averaging about 15 feet in thickness. The mantle is removed by erosion south of the deposits and assumes its position at the base of a complete Abo series a mile or so to the north.

This basal Abo member varies in texture from shaly sandstones, through sandstones and grits to conglomerate. The beds are arkoses and dip north about 10°. The copper minerals are more concentrated in the finer textured rocks but are more widely distributed in the coarser. The general grade of the ore is low, although a little medium-grade material could be sorted out. The mineralized area measures roughly about 1,000 by 2,500 feet. Many barren areas lie within this area.

Chalcocite is the primary copper mineral, and much of it has been oxidized to malachite with subordinate azurite. Some copper pitch was noted. Most of the copper mineralization seems to be a replacement of the cementing material between the sand grains and partly a replacement of the grains themselves. Some fracture filling was observed. Carbonaceous material is rare, and its replacement is unimportant. However, "chalcocite logs" reportedly were mined from the area.

The sedimentary beds show considerable local disturbance, mostly distortion by compaction, so that they assume a very rough parallelism to the erosion surface of the pre-Cambrian basement. Where best exposed in the large pit near the mill, the mineralization seems to be confined to the small synclines or troughs, whereas the anticlines generally are poorly mineralized.

Development was by innumerable shallow open pits, test pits, and adits. Most of the later work consisted of large pits scraped out of the ground with a bulldozer.

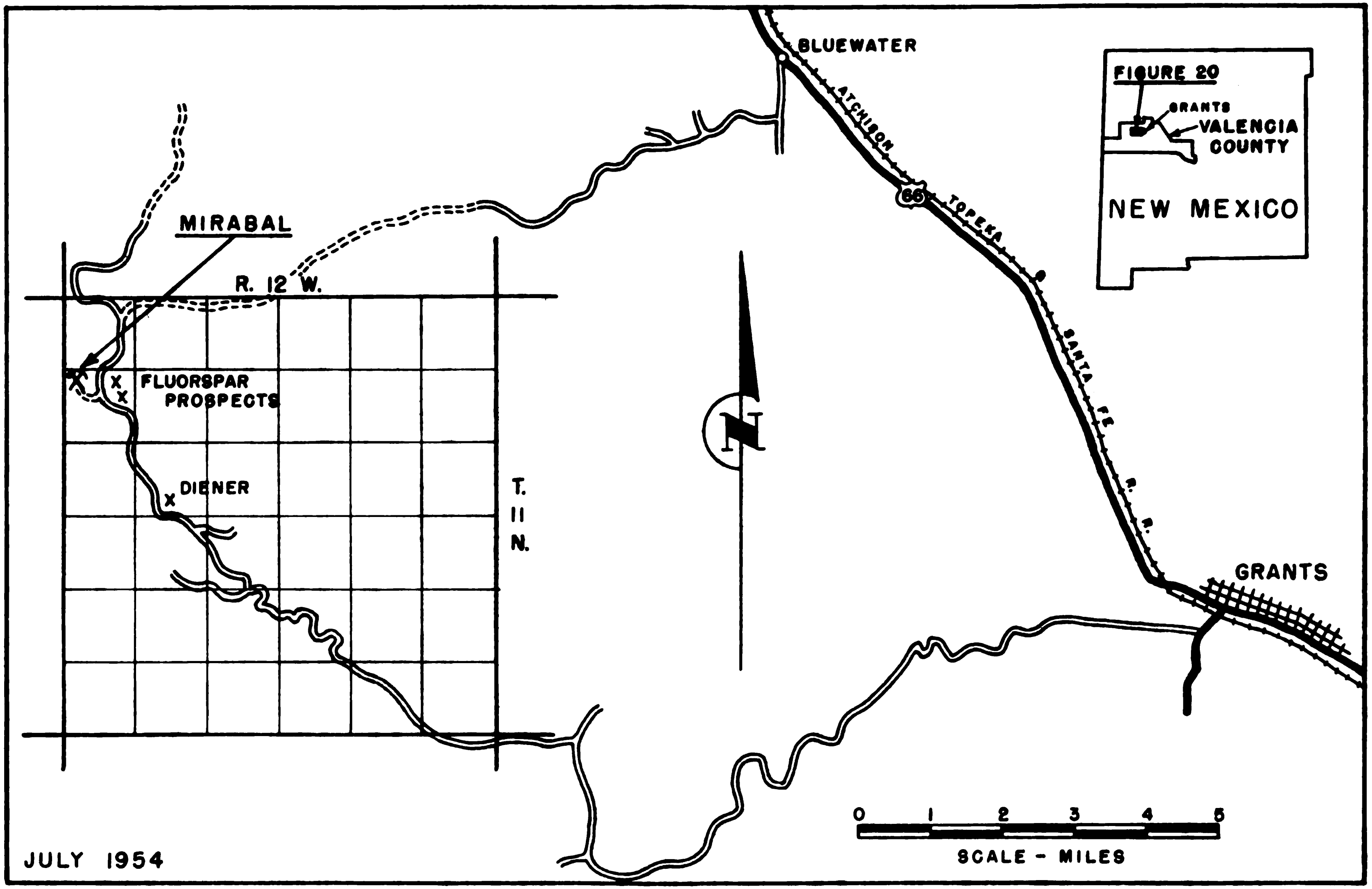

Figure 20. - Location map of Mirabal mine.

Other deposits in Valencia County are discussed under the Scholle district.

Deposit in McKinley County

Lindgren[19] states that "Prospects containing copper ores are said to have been found in the southeastern part of McKinley County, but no metal production of any kind is reported from either county." These may have been "Red Bed" deposits but were not visited because of their indefinite location.

Deposits in Sandoval County

Some of the most interesting "Red Bed" copper deposits are in the Nacimiento district of Sandoval County and the adjacent portions of Rio Arriba County, as shown on figure 21. The production of "Red Bed" copper from the district probably is second only to that of Guadalupe County. As reported in a Geological Survey publication,[20] about 3,150 tons of copper was produced from the district. This production was as of about 1905.

The San Miguel Mine

From the foregoing reference, the largest part of the Nacimiento district production (2,500 tons of copper) was obtained from the San Miguel mine. This property was discovered about 1880, was developed into a mine in 1884, and was operated until 1900. The ore was smelted at Copper Cities, about 10 miles north. A revival of interest occurred in 1918, and after a few shipments the mine was closed in 1920. Subsequent attempts at operation have been unimportant. Three patented claims comprise the nucleus of the property. These are the San Miguel, Copper Queen, and Palmer, which were owned by Mrs. Mary E. Pope of Pittsburgh, Pa., and Clyde W. Pope of Geneva, N. Y. in 1951. In 1944 lessees applied to the Smaller War Plants Corp. for a $15,000 loan to equip the property for a leaching operation. In 1951 sublessees applied to the Defense Minerals Administration for a production loan of $36,500 to place the mine on a productive basis.

The San Miguel mine is situated in the NE1/4 sec. 24, T. 19 N., R. 1 W., and is reached by going to La Ventana, N. Mex., about 50 miles northwest of Bernalillo, N. Mex., on State Highway 44, continuing north from La Ventana on the State highway for 4.0 miles, then turning right or east off the pavement and following a poor dirt road southeast and then north for 2.5 miles, turning right and going southeast for nearly 2 miles to a gap in the small range of hills. From this point the road is impassable, and one must walk southeast for a little over 1 mile to the mine. This last mile contains some very steep grades.

The copper mineralization occurs in the Poleo sandstone of Triassic age, which dips westward about 45°. The sandstone is slightly arkosic in places and generally is medium to fine grained. It seems that more than one stratigraphic horizon in the formation is copper bearing, and mine workings extend along the strike of the beds for about 1,000 feet.

Chalcocite is the primary copper mineral, and the oxidation products, malachite and azurite, are present. The ore seems to contain more chrysocolla than other "Red Bed" copper deposits. The copper mineralization occurs as nodules and disseminations in the sandstone; the disseminations seemingly replace the cementing material

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[19] See work cited in footnote 11, p. 77.
[20] See work cited in footnote 11, p. 77.

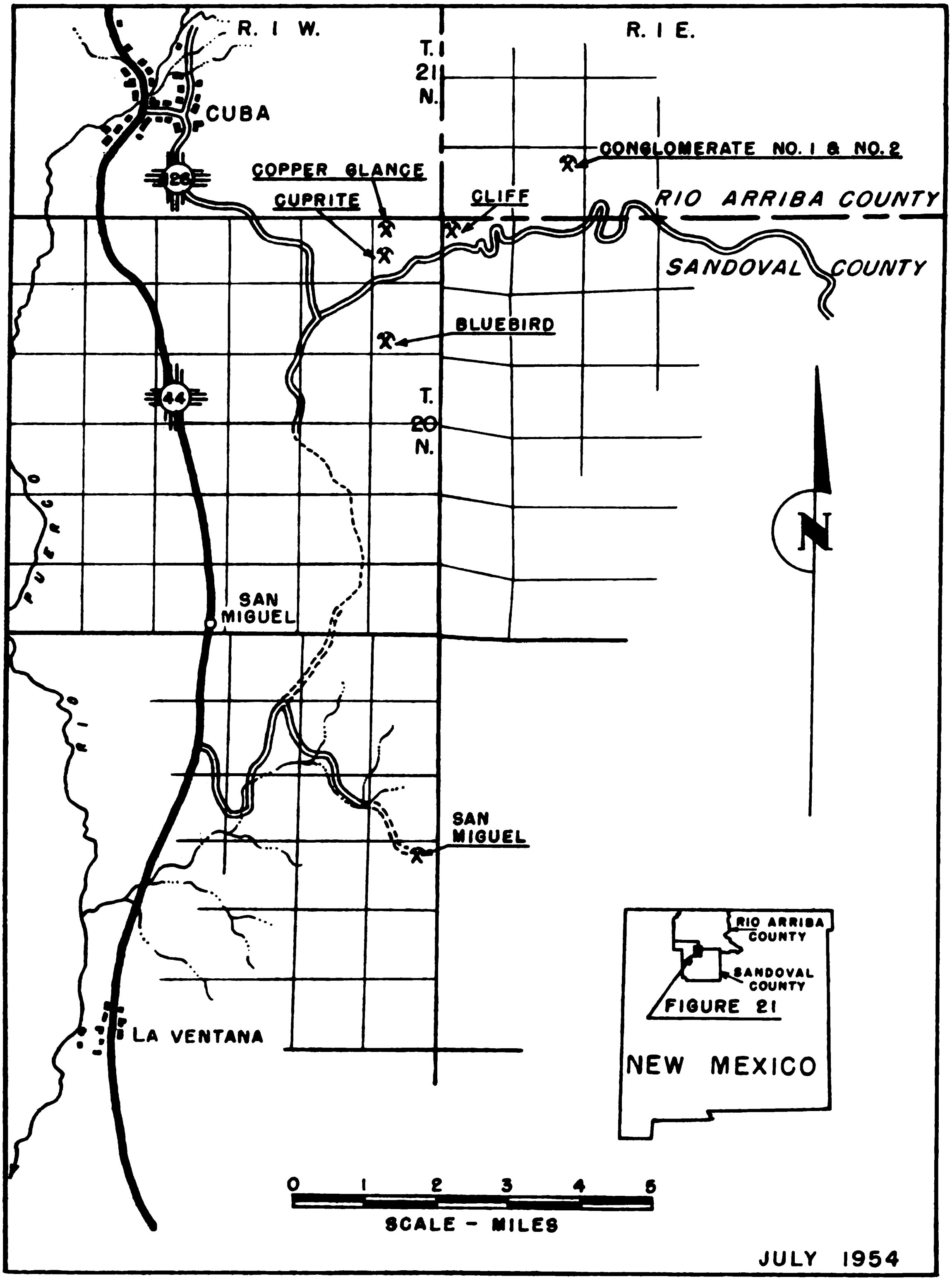

Figure 21. - Location map, Nacimiento district.

of the sandstone. There is much carbonaceous material, and most of the mined ore evidently was obtained from replaced trees and other carbonaceous fragments. According to Jenks, it was not rare to find trees as long as 60 feet with a basal diameter of 2-1/2 feet almost completely replaced by ore.[21] This is not evident today because all of the mine workings are caved and inaccessible.

The area in the vicinity of the mine is faulted, and the southern part of the mineralized zone terminates against a fault. The fault seems to be post-mineral, and the mineralization may exist to the south. A large fault occurs east of the mine. This fault strikes north along the west front of the Nacimiento Mountains.

The mine workings are inaccessible, and their description is quoted from Lindgren.[22]

> Five or six drifts or tunnels have been driven, nearly all along the strike, but as the mine has been abandoned for 6 years, owing to cave-ins and infilling of wash, these were not examined far beyond the mouth. The drifts and tunnels are all situated at different elevations, but do not seem to represent definitely spaced levels. The purpose of each seems to have been to follow an immediate exposure or lead of ore. The shorter ones are from 300 to 400 feet long and one of the larger, 700 or 800 feet. Some of them pass entirely through the ore-bearing strata into the underlying barren Red Beds.

In 1951 a Bureau of Mines engineer[23] sampled the mine dumps and the Cleary cut. Ten samples were taken, and the results are shown on figure 22. At the time of the sampling none of the mine workings were accessible.

The Copper Cities Group

The Copper Cities deposits are situated just 9 airline miles north of the San Miguel mine. There are four series of workings, the Copper Glance-Cuprite, the Bluebird, the Cliff, and the Conglomerate or Eureka. The Copper Glance-Cuprite claims are in the NW1/4 sec. 1, T. 20 N., R. 1 W., and the Bluebird claims are about 1-1/2 miles southward in or near the SW1/4 sec. 12 of the same township. The Cliff deposit is in the NW1/4 sec. 6, T. 20 N., R. 1 E. The above three areas are in Sandoval County, whereas the Conglomerate claims lie in the NE1/4 sec. 32, T. 21 N., R. 1 E., and just over the line in Rio Arriba County. These deposits are shown on figure 23.

Only the Copper Glance-Cuprite area is easily accessible. It is reached by traveling southeast from Cuba, N. Mex., which is on State Highway 44 and about 65 miles northwest of Bernalillo, the nearest railroad point, 5 miles to Senorita Canyon. Here the route turns left and continues eastward up Senorita Canyon for 1.3 miles, or just 0.3 mile east of the forestline as marked, turns left and leads north 0.8 mile, to the Copper Glance-Cuprite area. The areas of copper mineralization extend north and south for about a half a mile. The other three areas are accessible only by trail and with a guide.

The history of periods of productivity of the Copper Cities group closely parallels that of the San Miguel to the south. Most of the important work probably was done before the turn of the century, and very little has been done since. A small smelter was once erected on the property, and some ore was treated.

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[21] See work cited in footnote 11, p. 147.
[22] See work cited in footnote 11, p. 146.
[23] B. C. Brown, 1951.

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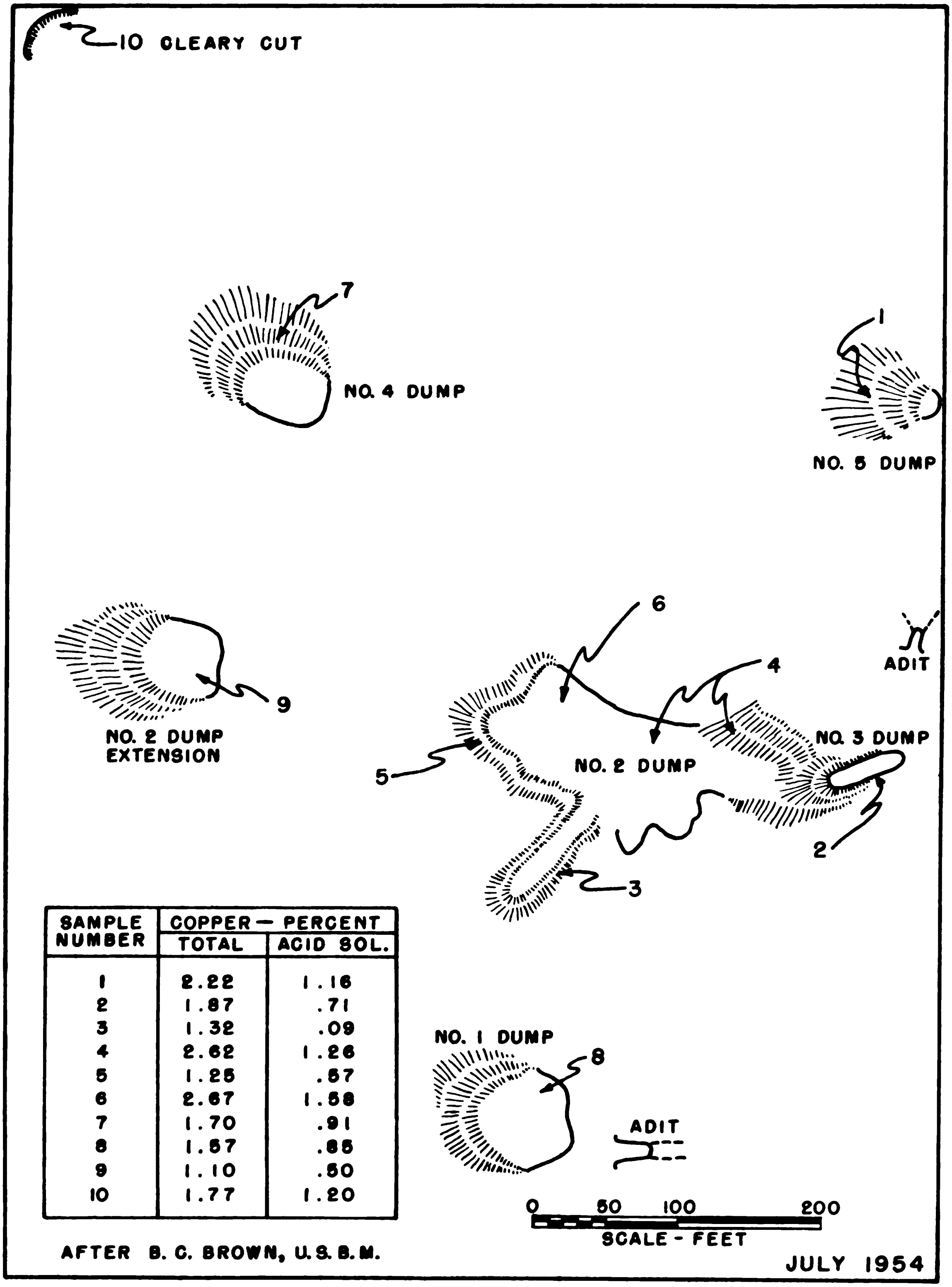

SAMPLE NUMBER	COPPER — PERCENT	
	TOTAL	ACID SOL.
1	2.22	1.16
2	1.87	.71
3	1.32	.09
4	2.62	1.26
5	1.25	.57
6	2.67	1.58
7	1.70	.91
8	1.57	.85
9	1.10	.50
10	1.77	1.20

AFTER B. C. BROWN, U.S.B.M.

Figure 22. - Sketch assay plan, San Miguel mine.

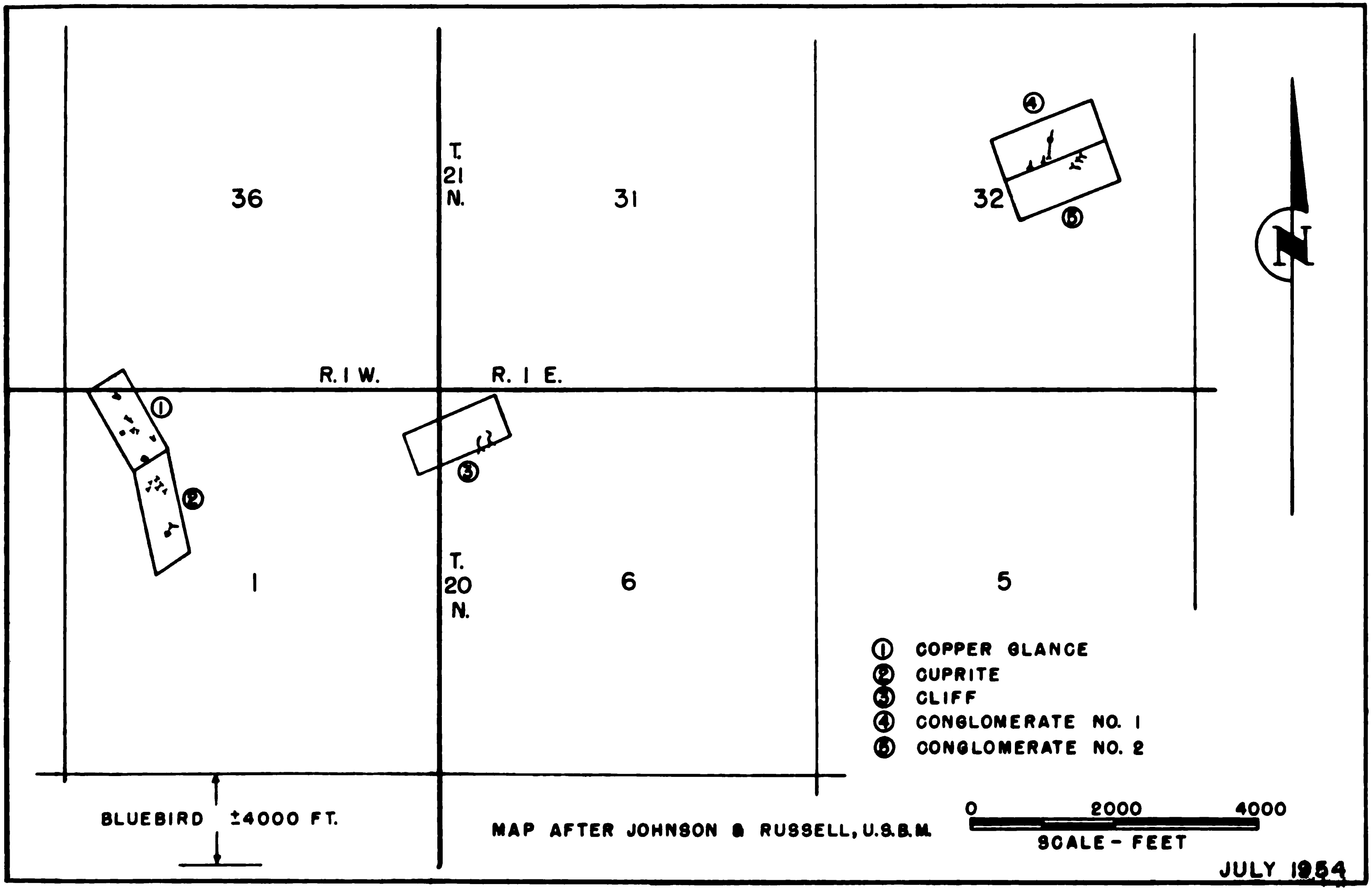

Figure 23. - The Copper Cities group.

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At all areas the copper mineralization occurs in the Poleo sandstone of Triassic age. This sandstone forms the capping of Eureka Mesa, overlying the red beds of the Abo formation. The sedimentary formations dip west about 33° at the Copper Glance claim and gradually flatten in dip as the mesa rises to the east. The dip at the Conglomerate claims 2.5 miles east of the Copper Glance claim is about 10° to the west. An arching of the beds is apparent, even though on a somewhat large scale. Just west of the Copper Glance claim the strong fault, already mentioned as occurring east of the San Miguel mine, passes through the country.

The sandstone varies in texture from fairly fine-grained to grit in the Copper Glance area and to conglomeratic at the Conglomerate claims. Much of the sandstone is only slightly arkosic; and calcite seems a predominant cementing material, except where replaced by malachite. Local crossbedding is exhibited, and fracturing, owing to arching of the beds, generally is coarse.

The replacement of carbonaceous material by chalcocite seems to be the important mode of deposition of the copper. The oxidation of the chalcocite in places, resulted, in the dissemination of malachite throughout the sandstone. The carbonaceous layers generally parallel the bedding and are quite thin. The ore thickness may average about 3 feet of mixed sulfide and carbonate ores. The strike length in the Copper Glance-Cuprite area may be 2,000 feet, but there are barren portions along the strike. It seens that more than one stratigraphic horizon is mineralized.

Mine workings consist of many short adits and other shallow workings, as shown on figures 24, 25, and 26. These workings were sampled in 1942 by Bureau of Mines engineers,[24] and the results of their work are also shown on figures 24, 25, and 26. One general sample was taken by the writer from the Cuprite area. The sample contained 2.19 percent copper and a trace of gold and silver.

The Spanish Queen Prospect

This prospect lies about 14 airline miles southeast of the San Miguel mine and in sec. 3, T. 17 N., R. 2 E. (See fig. 27.) This township is unsurveyed being on the Canon de San Diego Grant and the coordinates are projected. The area is reached by going to San Ysidro, N. Mex., on State Highway 44, 23 miles northwest of Bernalillo and from San Ysidro traveling north on State Highway 4 for 14.4 miles. The road parallels the Jemez River, and the mine workings occur on both sides of the river.

Indians and Spaniards may have done the first work on the deposits, which must have been insignificant. About 1924 the Burnett Mining Co. acquired the property and shipped a small quantity of ore to smelters in following years. Eventually considerable work was done and the property once had a mill, leaching plant, smelter, and sulfuric acid plant. The equipment and plants were small and have since been removed.

The copper mineralization occurs in flat-lying beds of the Abo Formation of Permian age. A slight monocline was one observed structural feature. Jointing and insignificant faulting are present.

Chalcocite was the primary copper mineral and malachite is predominant, seemingly, derived from the chalcocite. Some azurite is present. Most of the copper mineralization is confined to narrow beds of arkosic sandy shale a few inches thick.

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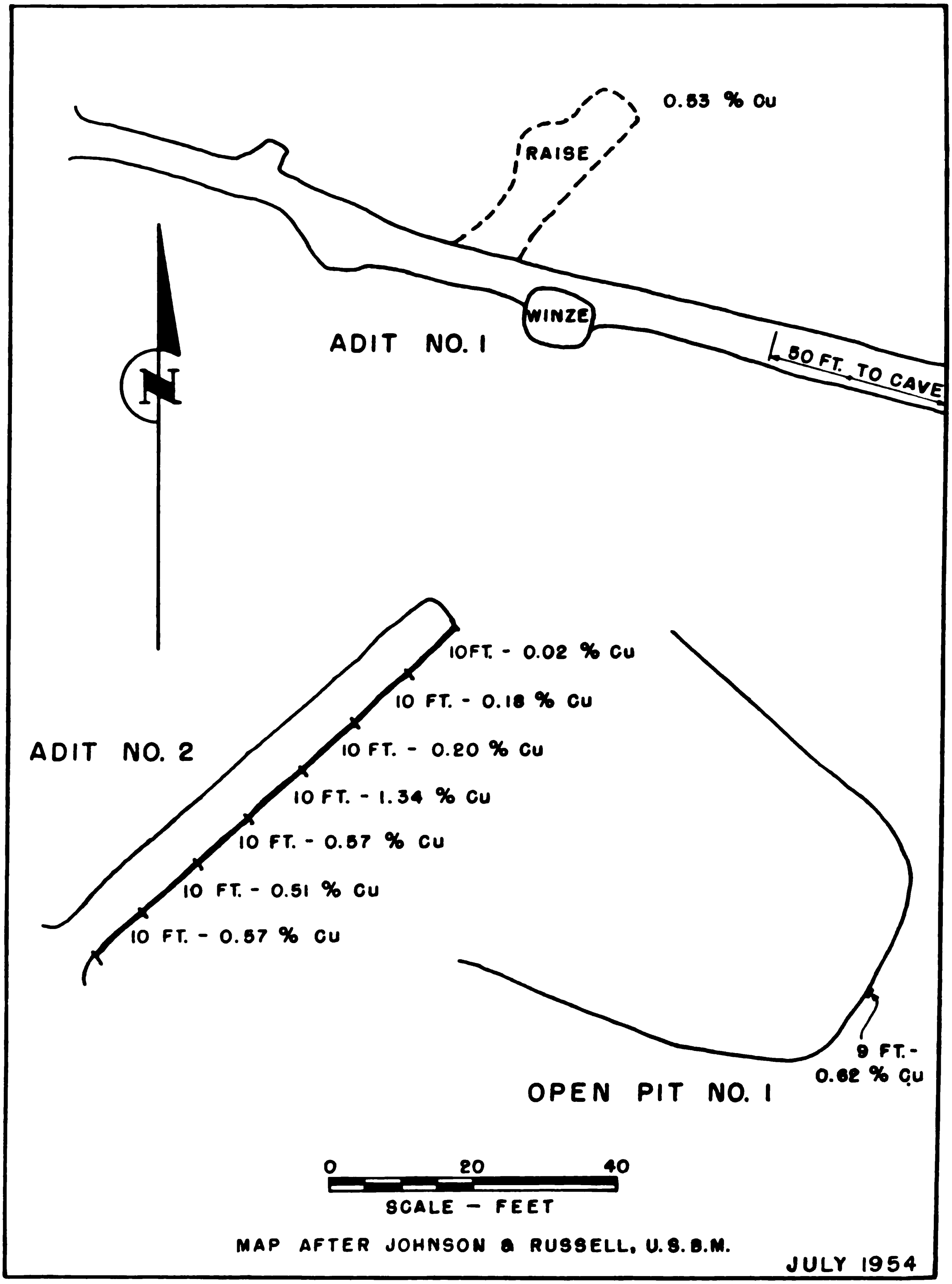
[24] C. H. Johnson, and P. L. Russell.



MAP AFTER JOHNSON & RUSSELL, U.S.B.M.

JULY 1954

Figure 24. - Assay plan of the Copper Glance mine.

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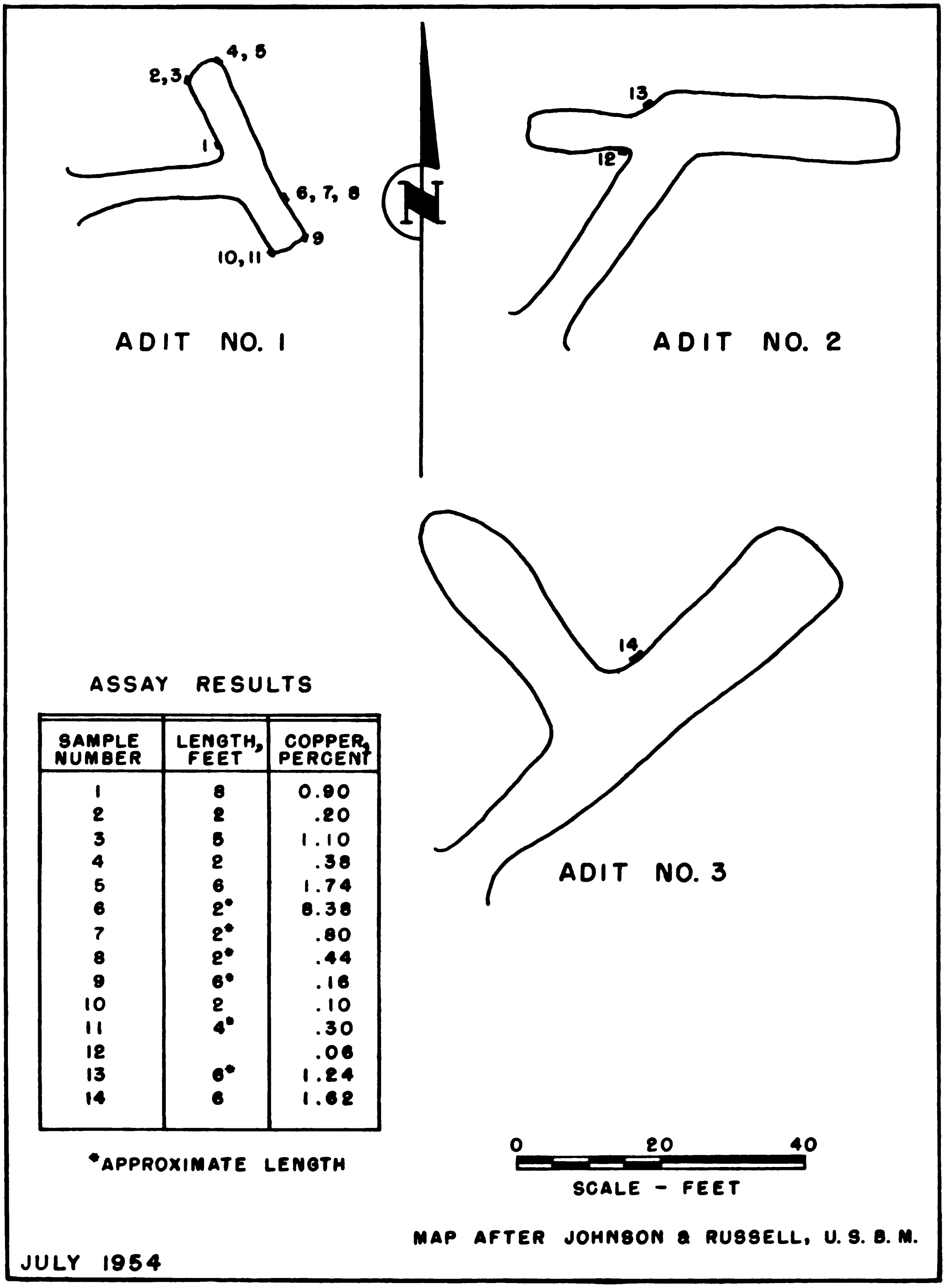


ASSAY RESULTS

SAMPLE NUMBER	LENGTH, FEET	COPPER, PERCENT
1	8	0.90
2	2	.20
3	5	1.10
4	2	.38
5	6	1.74
6	2*	8.38
7	2*	.80
8	2*	.44
9	6*	.16
10	2	.10
11	4*	.30
12		.06
13	6*	1.24
14	6	1.62

*APPROXIMATE LENGTH

MAP AFTER JOHNSON & RUSSELL, U. S. B. M.

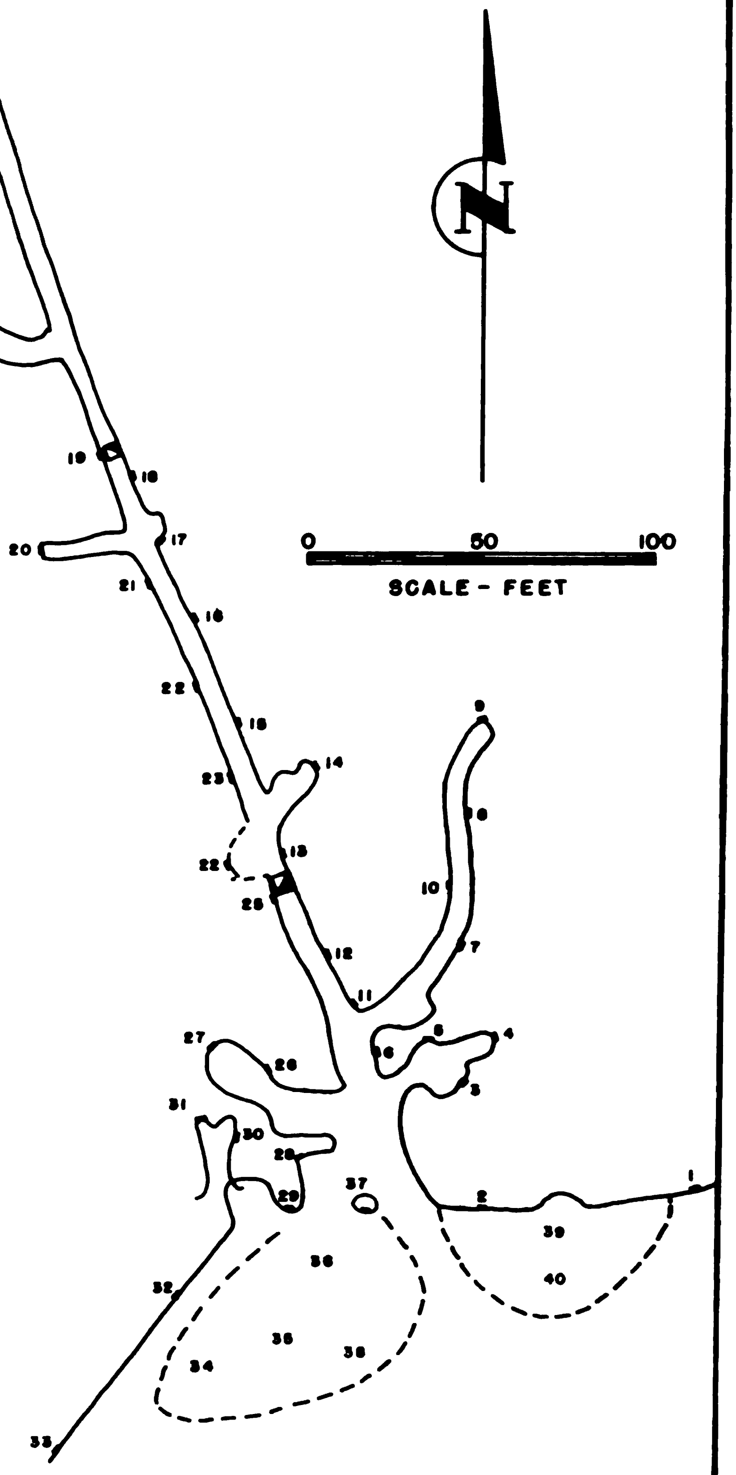
JULY 1954

Figure 25. - Assay plan of the Cuprite mine.

ASSAY RESULTS

SAMPLE NUMBER	LENGTH, FEET	COPPER, PERCENT
1	8	3.12
2	9	3.27
3	7	4.33
4	7	3.23
5	7	4.20
6	4	1.56
7	7	3.40
8	8	3.66
9	7	3.30
10	7	2.70
11	6	2.35
12	4	2.37
13	7	2.75
14	7	1.62
15	6	1.37
16	6	2.12
17	6	1.82
18	3	1.24
19	7	2.85
20	7	1.5
21	6	1.87
22	6	1.47
23	6	2.28
24	5	3.30
25	7	2.75
26	7	2.55
27	7	3.10
28	7	3.25
29	5	6.07
30	6	2.27
31	7	3.75
32	7	3.57
33	9	6.57
34	GRAB	4.05
35	GRAB	3.52
36	GRAB	3.57
37	8	3.35
38	GRAB	2.62
39	GRAB	4.05
40	GRAB	3.52

ALL CHANNEL SAMPLES
TAKEN VERTICALLY



JULY 1954

MAP AFTER JOHNSON & RUSSELL, U.S.B.M.

Figure 26. - Assay plan of the Conglomerate mine.

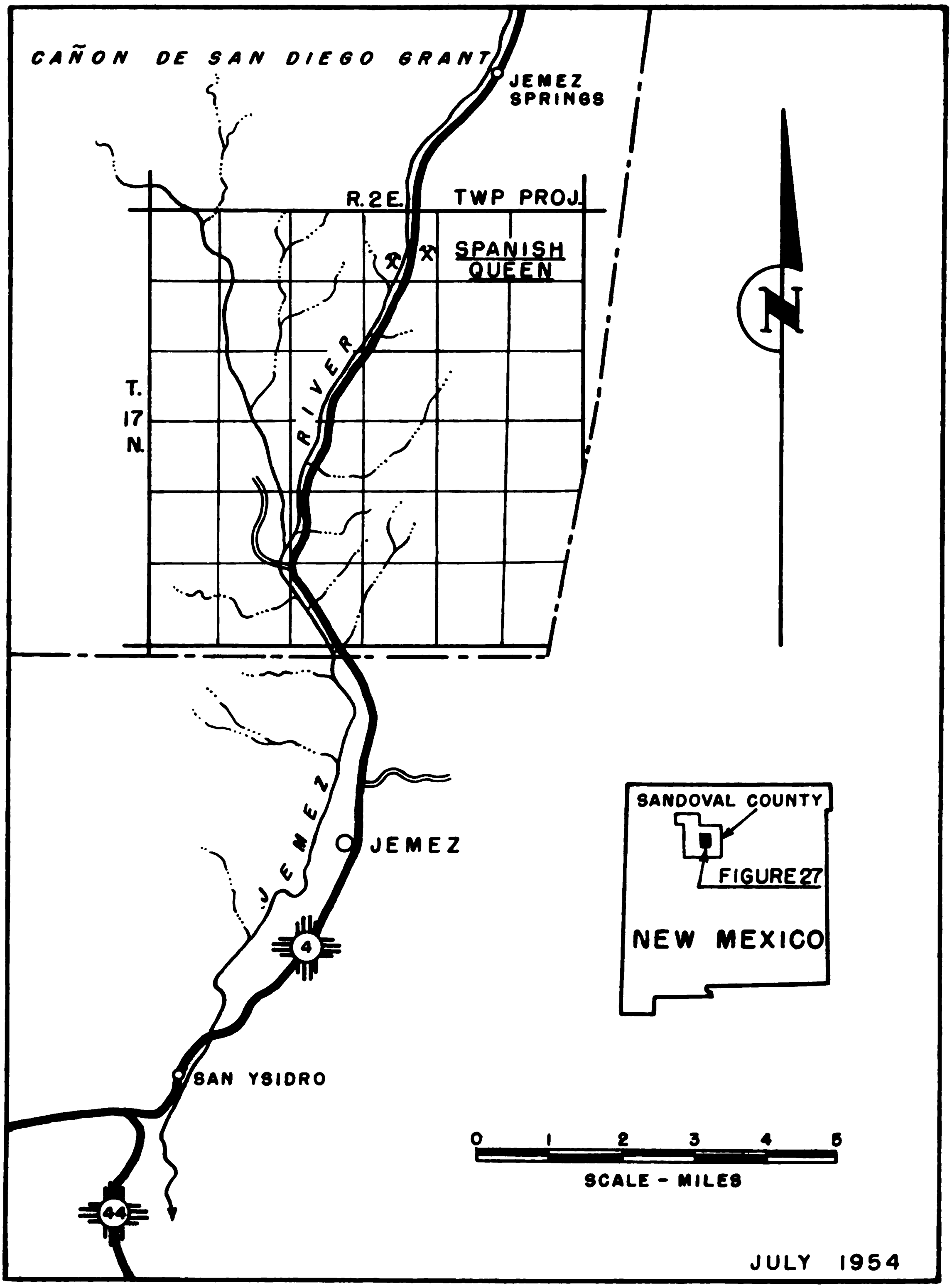


Figure 27. - Location map, Spanish Queen mine.

These beds are not continuous, and in one instance an aggregate of a few of the beds indicates a mineable thickness of ore of about 5 feet. This thickness is not persistent, and many exposures show only one mineralized shaly bed. A small amount of carbonaceous matter is present, but it seems to have been unimportant with respect to the copper mineralization.

All ore development was by adit. A 200-foot (?) shaft connects to 1 adit. The shaft collars in a red shale, passes through the sandy mineralized beds, and evidently bottoms in a red shale. A sketch of the workings is shown on figure 28. Two of the adits were inaccessible because of caving, and the total linear work done as adits, shafts, and raises may aggregate 1,800 feet. There is no equipment on the property.

Deposits in Rio Arriba County

The Gallina Deposit

This deposit is about 13 miles north of the Nacimiento district previously described and is in the Gallina mining district of Rio Arriba County. It is situated in or near the NW1/4 sec. 32, T. 23 N., R. 1 E., and may be reached by traveling south from the Gallina store in Gallina, N. Mex., for 2.1 miles, taking the left branch of the road and following this for 0.2 mile, and then taking the right branch south and east 1.8 miles to the mine. (See fig. 29.)

Copper has been known in the Gallina area for many years, having been reported by Lindgren.25/ In the work cited a Sefrina prospect was mentioned. This prospect probably is the one recently visited, and a location notice dated August 1951 named the claim Paradise Copper. Some small production may have been obtained from this property.

The copper mineralization occurs in an arkose varying in texture from a sandy shale to a conglomerate. The formation is the Abo of Permian age, and the beds dip northwestward from 5° to 10°. The primary copper mineral, chalcocite, seems concentrated in a narrow bed of sandy shale. Upon oxidation of part of the chalcocite, malachite was formed and replaced part of the cementing material in the coarser grained rocks. Thus the mineralized zone is thicker than the few inches shown by the sandy shale. Some azurite and melaconite (?) were observed. One sample was taken of material stockpiled, and it contained 1.30 percent copper, 0.50 ounce of silver per ton, and a trace of gold. A small amount of carbonaceous material was seen.

Old work done on the prospect may have consisted of shallow adits and pits, but in more recent work a bulldozer was used resulting in a pit measuring perhaps as much as 50 feet in diameter. The bulldozing somewhat obscured the structure, but it seemed that there was a marked sagging or synclinal bending of the beds.

On the road to the above prospect and about 1.4 miles south of Gallina, two adits, one on each side of the road, were passed. An inspection of the dumps revealed that there was no copper mineralization present.

25/ See work cited in footnote 11, p. 148.

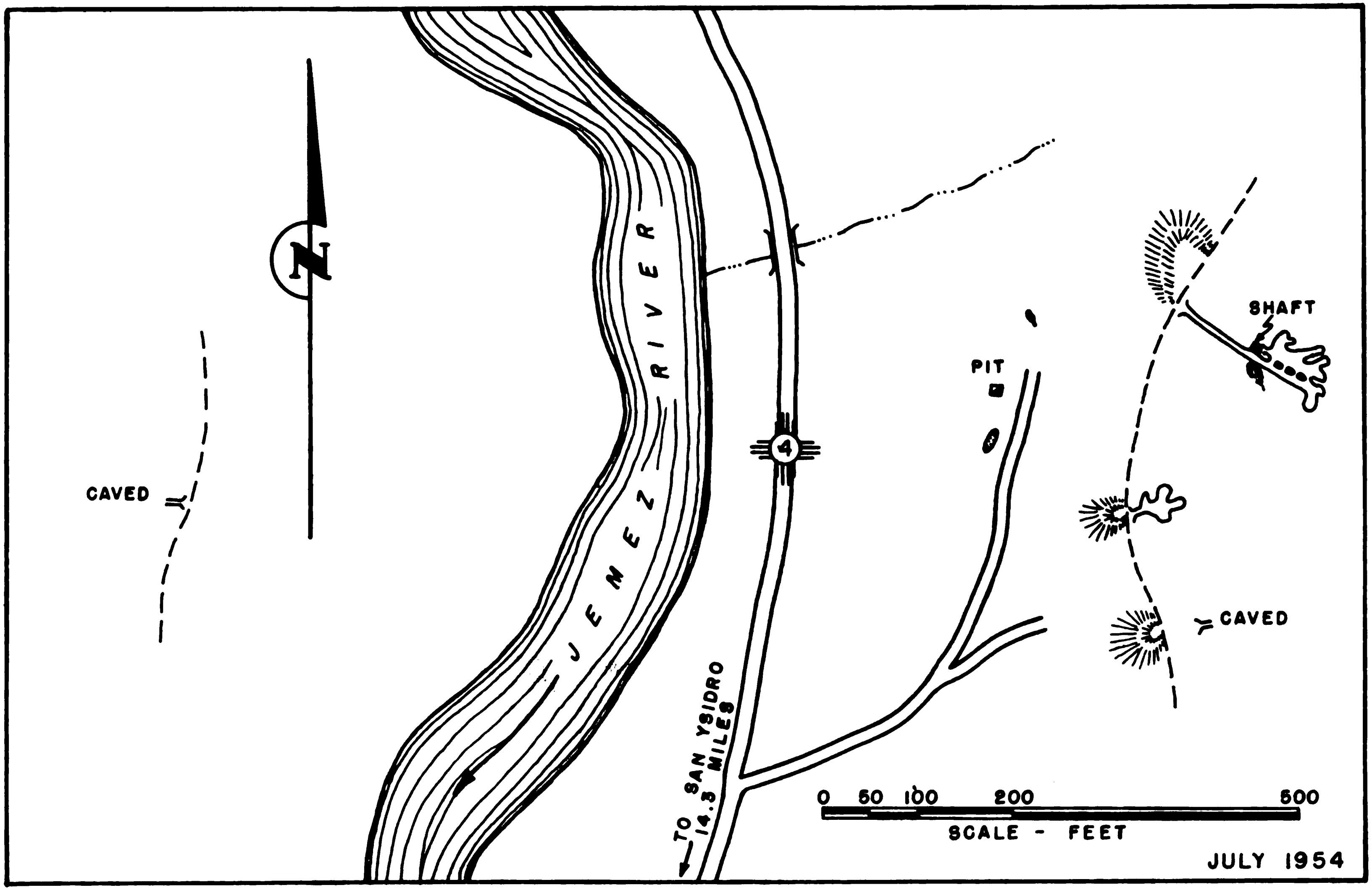


Figure 28. - Workings of the Spanish Queen prospect.

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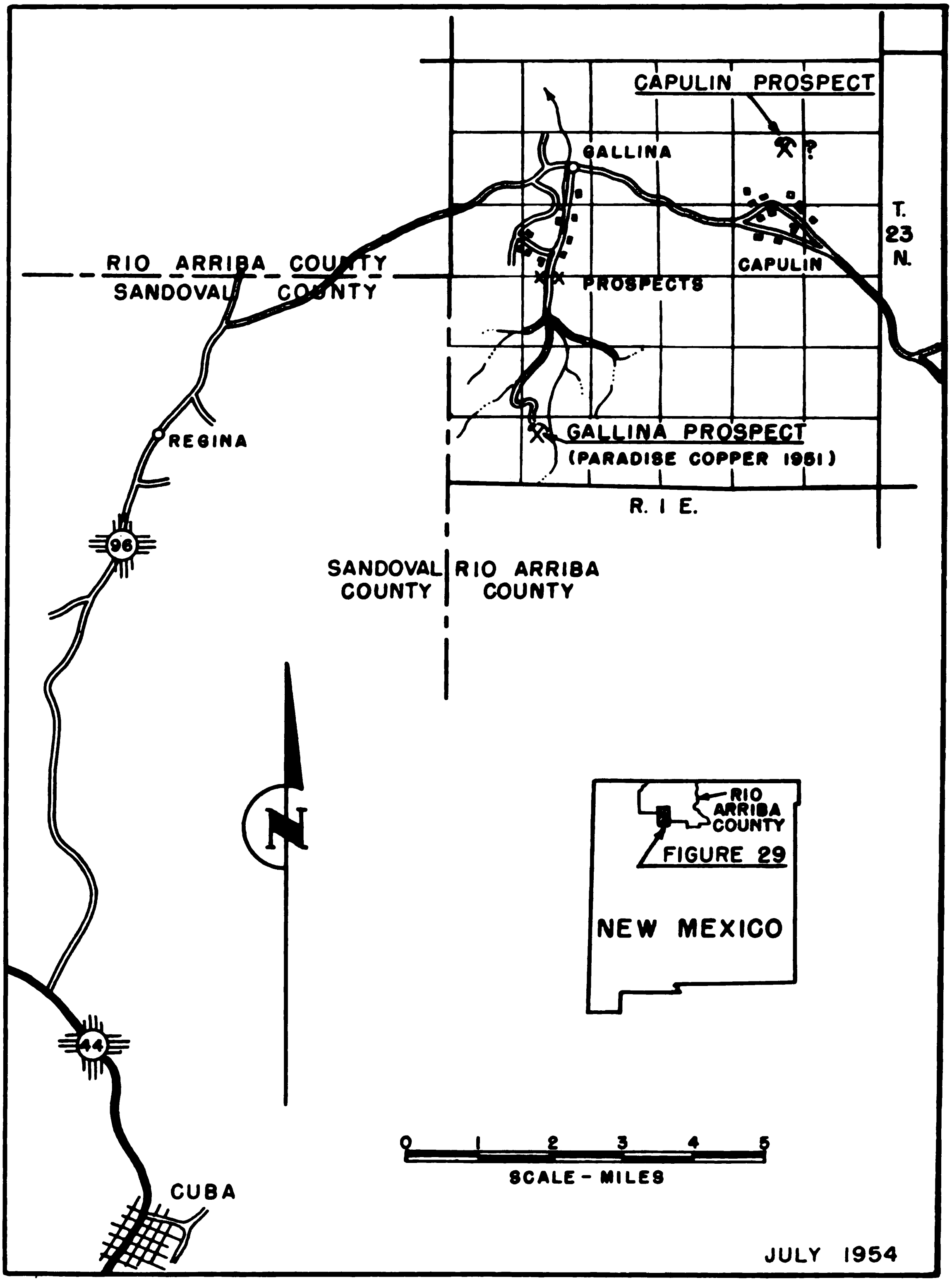

Figure 29. - Location map, Gallina deposit.

Capulin Deposit

Near Capulin, a few miles east of Gallina, a copper deposit was reported,[26] but there is no information about the deposit other than that it is similar to the Jarosa deposits described later.

Deposit near Coyote

About 12 miles east and a little south of the Gallina deposit at Rio del Agua, 2 miles west of Coyote, N. Mex., a copper deposit was noted. (See fig. 30.) This deposit is in or near the NW1/4 sec. 8, T. 22 N., R. 3 E. It is reached by going to Coyote, N. Mex., then 1.8 miles west to Rio del Agua, turning sharply left about 100 yards before reaching the highway bridge at Rio del Agua, and continuing up the eastern side of a creek for about 0.25 mile to the prospect. This may be the Serrano deposit noted in the Bureau of Mines former Silver City field office files.

The Abo formation of Permian age outcrops in the area and is generally flat lying, with a gentle dip northward. The mineralized rock is an arkosic grit and conglomerate in which malachite is sparsely disseminated as a replacement of the cementing material. The mineralized zone averages less than 1 foot in thickness and is not traceable for any appreciable distance. No carbonaceous material was seen.

The prospect has been developed by two adjoining open pits bulldozed into the steep hillside a short distance above the creek. Most of the work was done in a red shale bed that underlies the coarser copper-bearing material.

Jarosa Deposits

Two small deposits are situated in the Jarosa area a few miles south of Coyote, as shown on figure 30. They are reached by going south from Coyote for 5.4 miles, taking the right branch of the road for an additional 6.4 miles to Jarosa, taking the right fork of the road 0.5 mile southwest of Jarosa, and continuing southwest from Jarosa for 1.6 miles to Erma deposit. By taking the left forks of the road at 3.0 and 4.3 miles from the Erma deposit and continuing south for 5.3 miles from the Erma (1954) deposit, the Little Joe (1953) deposit is reached. Both above prospects are adjacent to the road.

The Erma prospect is in sec. 23, T. 21 N., R. 2 E., Rio Arriba County, whereas the Little Joe prospect is in or near sec. 3, T. 20 N., R. 2 E., just over the line in Sandoval County.

Both deposits occur in arkose varying in texture from fine-grained sandstone to conglomerate. These beds are in the Abo formation of Permian age. They are nearly flat lying.

A little chalcocite was noted in the finer grained arkose, and oxidation of part of the chalcocite seems to be the source of the malachite that permeates some of the coarser arkoses. The mineralized zone is narrow and patchy, with the better concentrations of the copper minerals along the bedding planes. Some carbonaceous material was observed, but it does not seem to be important.

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[26] See work cited in footnote 11, p. 148.

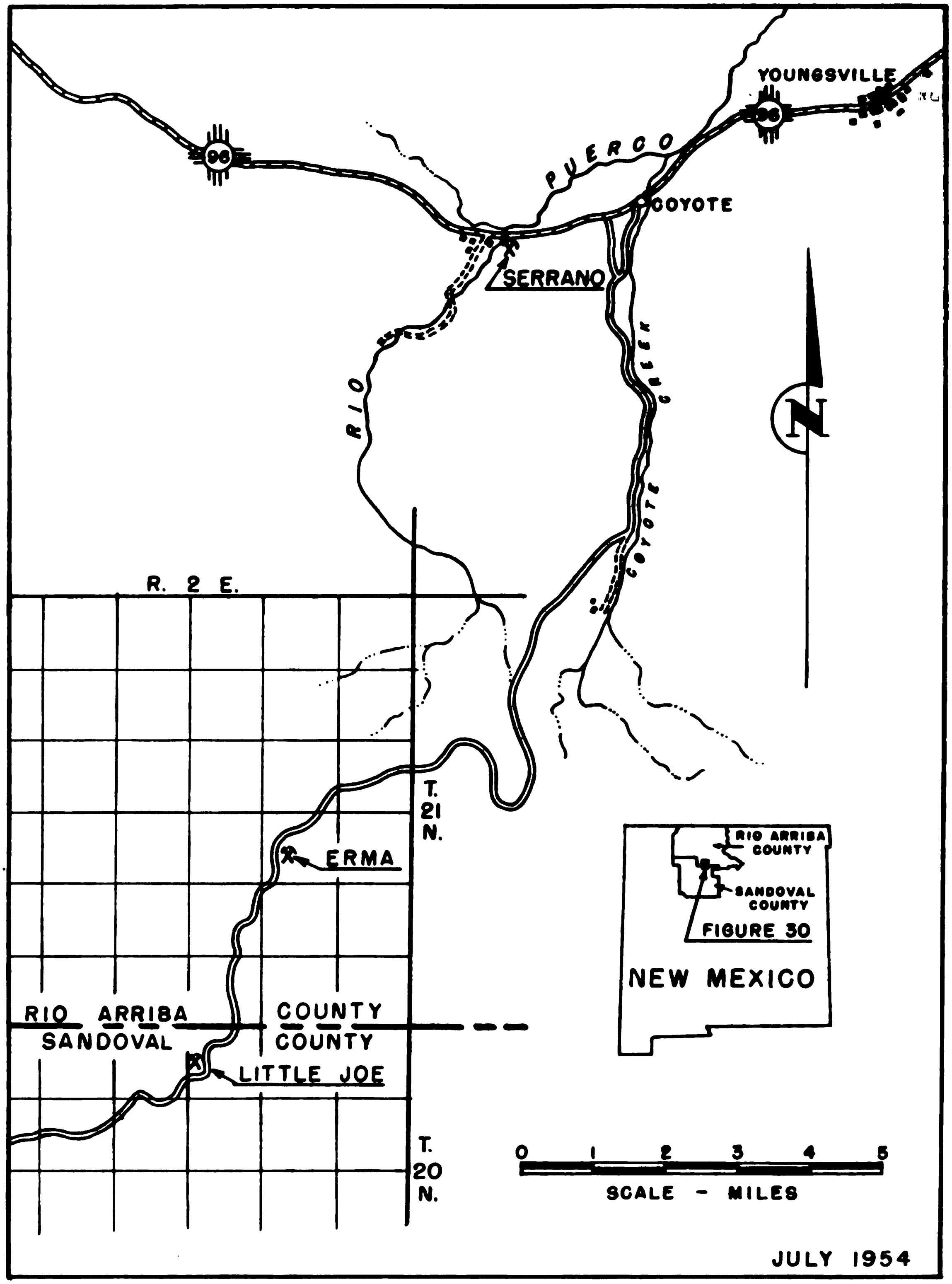

Figure 30. - Location map of the Coyote and Jarosa deposits.

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Both prospects were developed by bulldozing small pits, and there is a suggestion of older work by hand methods at the Erma prospect. General samples were taken at both localities. The Erma sample contained 3.38 percent copper, 0.45 ounce of silver per ton, and a trace of gold. The Little Joe sample contained 1.87 percent copper, 0.20 ounce of silver per ton, and a trace of gold.

Youngsville Deposits

Copper minerals have been reported 2 miles east of Youngsville, which is about 3.5 miles northeast of Coyote. This area was visited; and a few shallow pits were seen, but no copper minerals were noted. The Poleo sandstone of Triassic age in the predominant rock in the area and farther to the south is covered by the Todilto and Morrison formations. It is possible that copper minerals occur in the area.

Abiquiu Deposits

East of Youngsville and north of the little hamlet of Abiquiu are more "Red Bed" copper deposits. The area is reached by traveling U. S. Highway 84 for 1.4 miles west from Abiquiu to a corral just north of the road, turning right at this point, skirting the corral, and traveling north up Arroyo del Cobre. (See fig. 31.) One group occurs about 1/2 mile due east of a point 5 miles from the highway, and another group is situated east of a drill hole nearly 7 miles from the highway. Both groups are in cliffs bordering the east canyon wall of the Arroyo del Cobre. Additional workings may exist high on the north rim of the canyon and north of the workings previously mentioned. Another deposit is reported in the canyon bottom. Most of the deposits are situated on the Plaza Colorado land grant.

In the workings inspected the copper minerals occur in the Poleo sandstone of Triassic age. The texture of the rock varies from fairly fine grained sandstone through grits to conglomerates. The beds dip gently east and south. The Abo "Red Beds" underly the Poleo sandstone.

Here, as in the other deposits that occur in the Poleo sandstone, the replacement of carbonaceous material seems to be the important mode of deposition of the copper minerals. The primary copper mineral is chalcocite. The oxidation of this chalcocite resulted in nodules, stringers, and patches of malachite. Azurite is sparingly present.

The mine workings at the most southern deposits consisted of several shallow adits in the cliff face. One of the adits continued into an inclined shaft about 30 feet deep with a crosscut. The inclined shaft is remarkable in that it seems to have been excavated entirely by pick and shovel. Outside of the first few feet of the adit, there is no evidence of explosives having been used. The workings to the north are more extensive.

The Scholle District, Socorro, Valencia, and Torrance Counties

The Scholle district overlaps the adjoining corners of Socorro, Valencia, and Torrance Counties, as shown on figure 32. Most of the deposits are in Torrance and Valencia Counties and are in secs. 14, 15, 16, 21, 22, 23, 27, 28, 33, and 34, T. 3 N., R. 5 E. The area is easily accessible and may be reached by going to Scholle, N. Mex., on U. S. Highway 60. From Scholle, traveling westerly on this highway for 0.5 mile, turning right off the highway just before the railroad underpass, and traveling north. Old mines and prospects are to be found near the top of the lowest line of low cliffs bounding the valley on the east. The mines are found from

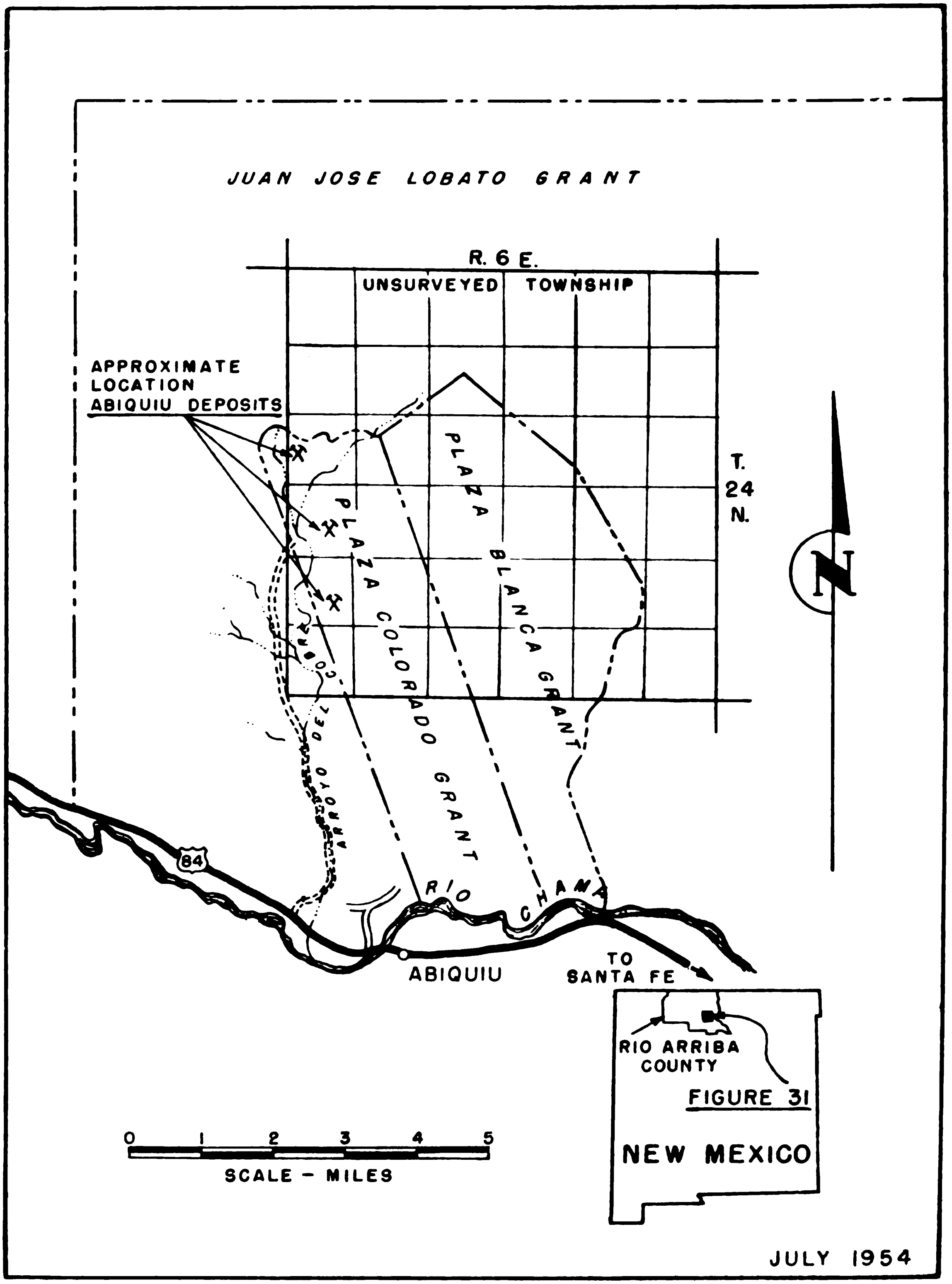

Figure 31. - Location map, Abiquiu area.

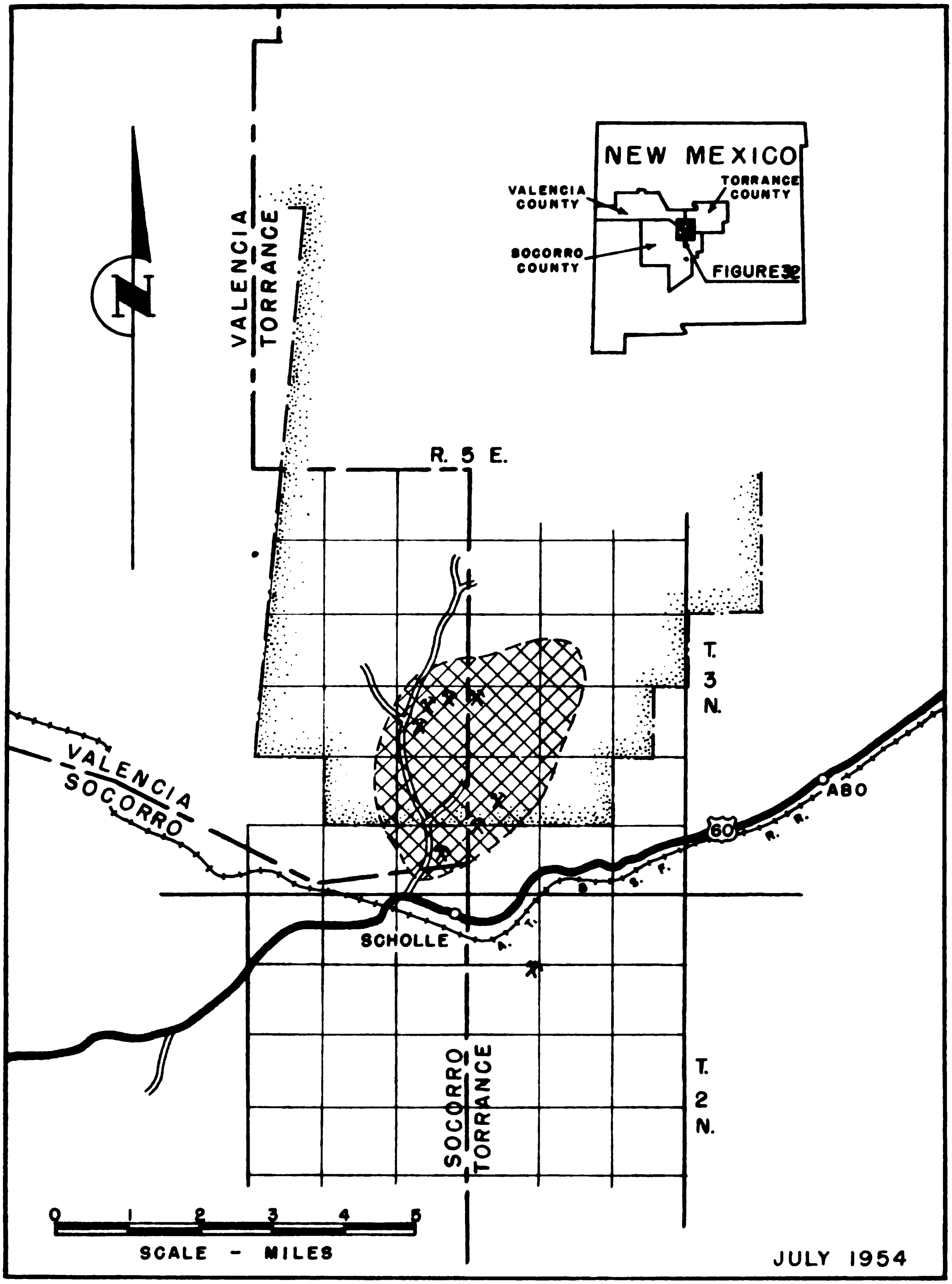

Figure 32. - Location map, Scholle district.

0.5 to nearly 5 miles noreast of the highway. By leaving the highway, traveling north for 1 mile, taking the left fork of the road, and, continuing on this well-traveled branch, taking all turns to the right, another series of deposits is in the valley flats 2.5 to 3.5 miles from the highway. The deposits lie near and east of the road.

Many claims were located in the area, but there is some difficulty in affixing the proper name to the mine working. Various claim and mine names are or were: Pritchard, 1.25 miles north of Scholle; Jackrabbit, Blue Jay, Piedmont, Star, Robinson, Doyle, Rambling Jack, 2-1/2 miles north of Scholle; Loraine; and Hawkeye. These are north of Scholle, and the Blue Star is about 1 mile S. 50° E. of Scholle.

The copper deposits have been known for many years, having been mentioned by Emmons[27/] in 1905. As near as can be determined, activity did not amount to much until about 1915, and small quantities of ore were produced sporadically until World War II. During the past few years the area has been the scene of intense prospecting for uranium.

A single description of the deposits suffices, as they vary only in size and location. All of the deposits occur in the lower part of the Abo formation of Permian age and a short distance above the Magdalena limestone of Pennsylvanian age. The mineralized beds are arkoses, often micaceous, varying in texture from sandy shales to grits. It seems that the primary copper mineralization was confined to a rather narrow undulating layer of sandy shale averaging a few inches in thickness. However, oxidation of the primary copper mineral, chalcocite, in the thin, sandy shale seems to have resulted in a permeation of the adjacent sandstone with malachite, the predominant copper mineral. This dissemination makes the mineralized beds a maximum of a few feet thick, but this thickness is not extensive. The average thickness of the mineralized beds probably averages less than 2 feet. Carbonaceous material is rare or absent in most of the district but a small amount of replacement by chalcocite of the carbonaceous material was noted in the northwestern part of the district.

The sedimentary formations are flat lying with a suggestion of a slight dip to the northeast. Structural deformation is slight and seems to be confined to a localized gentle flexing of the beds.

All of the deposits are near the surface and were developed by pits, trenches, and other shallow workings. One shaft of unknown depth was sunk on a deposit about 0.5 airline mile north of Scholle. An inspection of the dump showed that there was copper mineralization at or near the collar and that no copper mineralization was encountered at depth. From the size of the dump, this shaft probably did not exceed 50 feet in depth.

Some sampling in the area was done by mining engineers of the Bureau of Mines, and the sample results are reported herein to indicate the grade of the material exposed.[28/]

27/ Quoted in work cited in footnote 11, p. 77.
28/ Federal Bureau of Mines, Silver City, N. Mex., Field Office files.

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TABLE 5. - Sampling in the Scholle district

Character	Location	Length, feet	Copper, percent
Malachite and carbon	Blue Star	7.0	1/1.71
Malachite in arkose clay..	Rambling Jack	1.5	1/3.08
Do.	Mile west Scholle	1.5	1/2.49
Ore pile	Jackrabbit	Grab	2/5.72
Cut in pit, shale	do.	1.6	2/ .69
Do.	do.	1.3	2/ .58

Samples from Bluejay claim shown on figure 33.

1/ M. G. Huntington.

2/ R. J. Holmquist.

In addition to the above sampling, Holmquist did some wagon drilling on the Rambling Jack, Piedmont, and Jackrabbit claims. Evidently the samples were considered barren and were not analyzed.

Deposits in Socorro County

The extreme southern tip of the Scholle district, described in the preceding section, lies in Socorro County. In addition, there are the Rayo district a few miles southwest of Scholle and the Chupadera mine a few miles east and north of the town of Socorro.

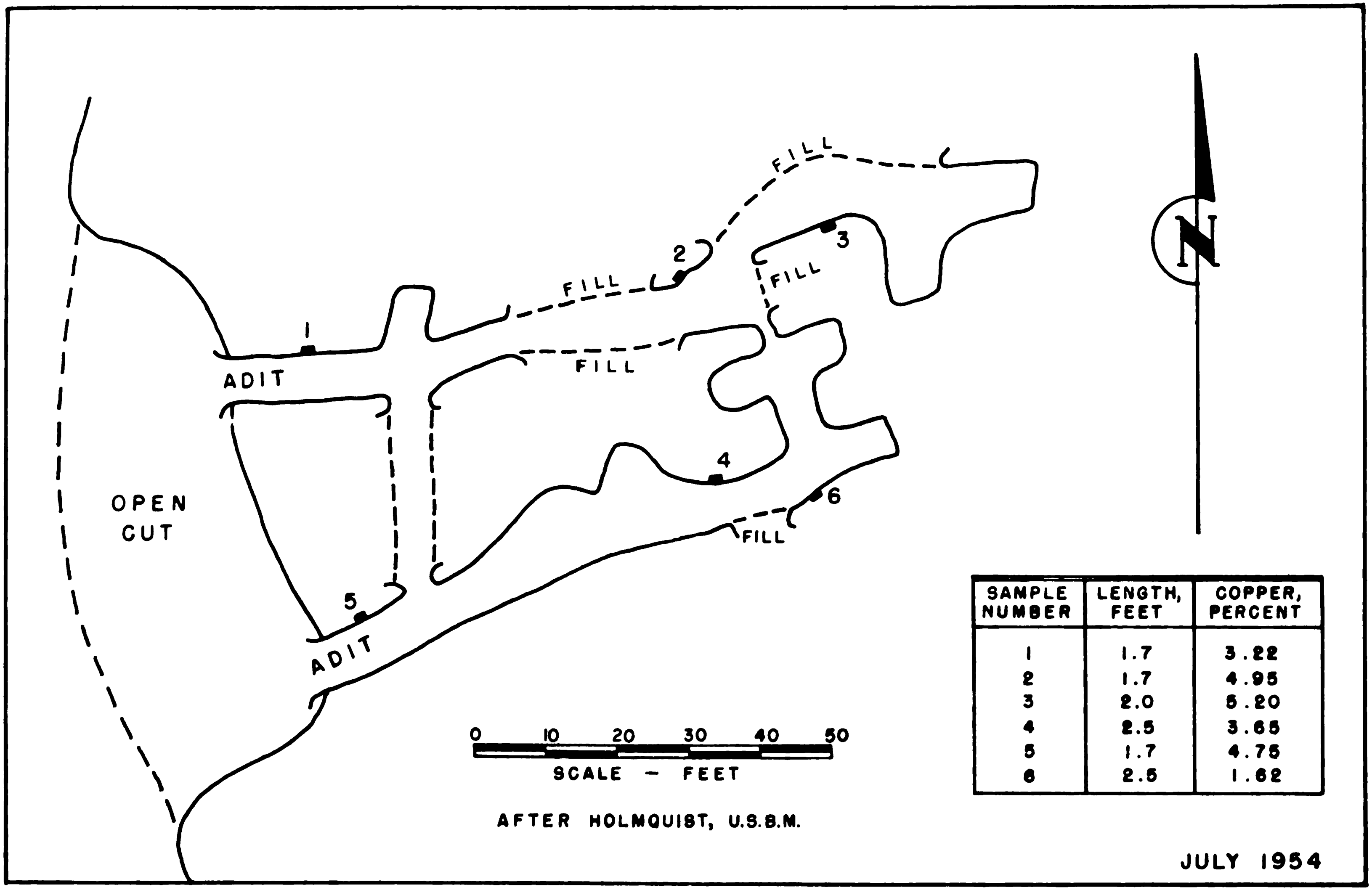
Rayo Deposits

Starting about 8 miles southwest of Scholle and extending south about 2 miles more are the Rayo deposits. These are in secs. 9, 10, 16, and 21, T. 1 N., R. 4 E., in the north central part of Socorro County. The area is easily accessible. It may be reached by going west on U. S. Highway 60 4.5 miles from Scholle, south for 6 miles,and west for 1 mile. The first deposits are situated nearly one-half mile south of the road. By continuing on this road for about 4 miles, other deposits can be found south and east of the road. (See fig. 34.)

Parker-Doyle prospects. - The Parker-Doyle prospects are the northermost deposits of the area. Here, the copper mineralization occurs in a light sandstone well up in the Abo formation of Permian age and not too far below the overlying Chupadera formation, also of Permian age. The mineralized beds occur at a much higher stratigraphic level than those at the Scholle district a few miles to the north. The sedimentary formations are flat lying.

Malachite is the principal copper mineral; it occurs as a cementing material between the medium-size sand grains. No chalcocite was noted, and no carbonaceous material was seen. There has been insufficient development work done to give a clearer picture of the general geology. A slight flexing of the beds was noted.

Development was by a few shallow pits scattered over a wide area. The largest pit was 75 feet long and about 8 feet wide and was sunk 6 feet, the deepest penetration into the mineralized beds in the area. The Bureau of Mines did a little wagon drilling on the property in 1943 in an effort to explore between some of the far-spaced mineralized areas. Twenty-nine holes were drilled for a total of 455 feet, according to records. The maximum depth penetrated was not recorded. Thirteen samples of drill cuttings from 12 holes were analyzed. The maximum copper content reported was 0.37 percent. Another sample contained 0.20 percent copper, and the



SAMPLE NUMBER	LENGTH, FEET	COPPER, PERCENT
1	1.7	3.22
2	1.7	4.95
3	2.0	5.20
4	2.5	3.65
5	1.7	4.75
6	2.5	1.62

Figure 33. - Sketch of Bluejay workings.

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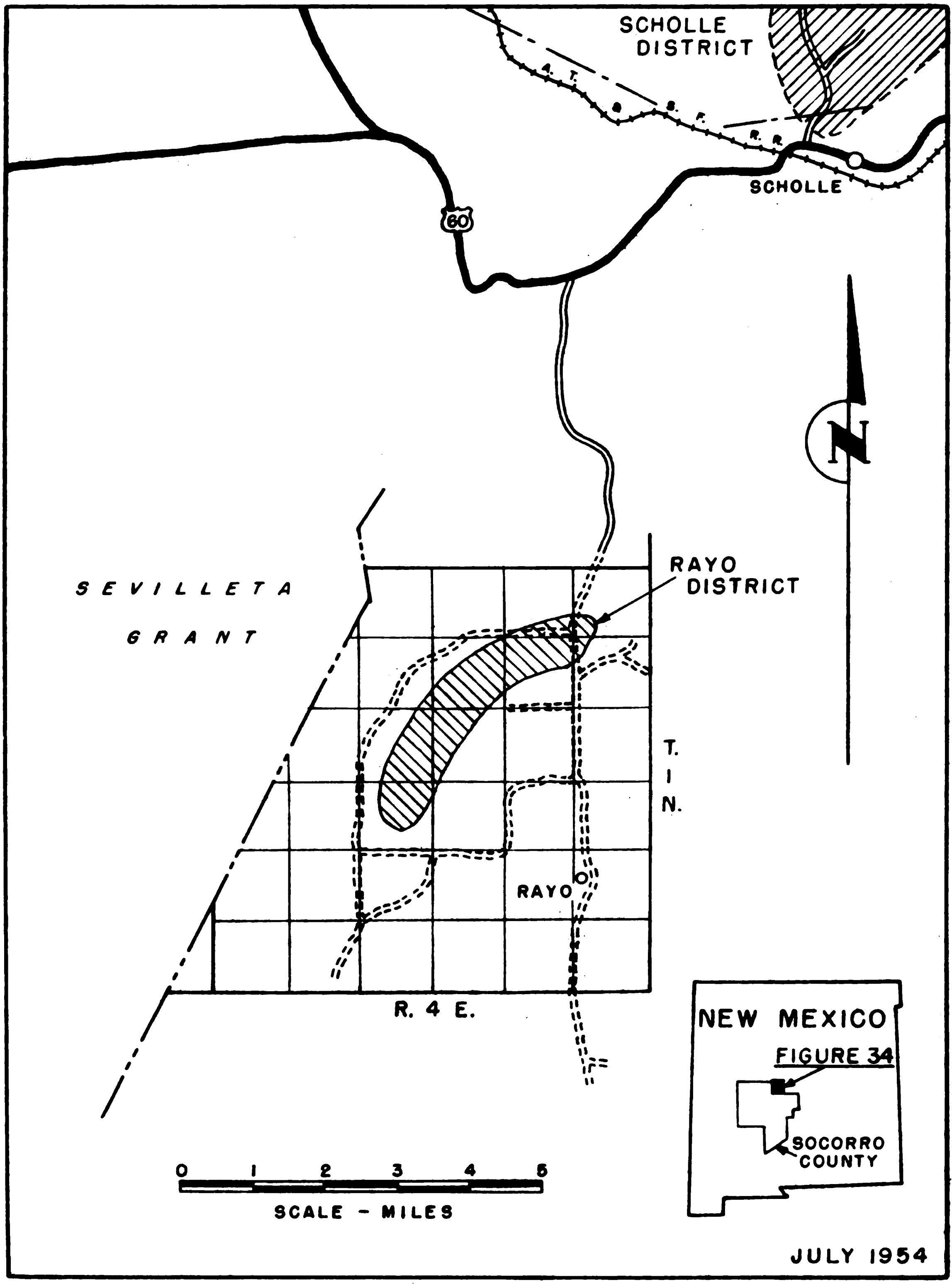

Figure 34. - Location map, Rayo district.

remainder contained less than 0.20 percent. From the 6-foot pit, 3 samples that averaged 0.85 percent copper were taken in 1942.[29] This test was verified by a metallurgical sample taken in 1943, which also contained 0.85 percent copper.[30]

Because the few pits over a large area could indicate a large potential of very low grade copper ore, a metallurgical sample was submitted to the Rolla, Mo., Station of the Bureau of Mines for testing. Both flotation and acid-leaching methods were tried, with the following results:[31] By flotation, about 64 percent of the copper in the ore was recovered in a concentrate containing 38.1 percent copper. The recovery could be increased by finer grinding. By acid leaching, nearly 99 percent of the copper was extracted in 1 hour from a minus-28-mesh ore, and the acid consumption was 34 pounds per ton of ore.

Other deposits in the district. - Extending south from the Parker-Doyle property occur other slightly explored deposits. The workings consist almost entirely of shallow cuts and trenches, and the copper mineralization seems to be in the same stratigraphic horizon as at the Parker-Doyle. However, the character of the mineralization is different. Here chalcocite occurs as nodules in addition to the malachite permeating the sandstone. No carbonaceous material was seen. The average grade of the mineral-bearing rock is very low. Probably no production was derived from these deposits; and judging from the condition of the workings, no work has been done in the area for many years.

Chupadero Mines

The Chupadero mines are situated about 6 miles northeast of Socorro, N. Mex., and in sec. 26, T. 2 S., R. 1 E.[32] The area is not easily accessible because of the poor roads. It may be reached by leaving Socorro and traveling north on U. S. Highway 60 for 1 mile, taking the right fork and following the dirt road for 1.8 miles, turning sharply to the right (east), and crossing the railroad tracks and the Rio Grande; 0.9 mile from the railroad, a poor road follows south, and in 1 mile a poor trail leads left up a sandwash. The road leaves the wash after a couple of miles and follows a ridge. This road is traveled for 3.2 miles from the last turnoff. The prospect lies south of the road and further progress must be made on foot (see fig. 35). The mine workings mentioned by Lasky[33] were not located, but it is certain that the area was visited.

Only very shallow workings were found, and there was no trace of copper in the formations. A description of the deposit is quoted from Lasky.[34]

> Copper carbonates occur mainly in a thin-bedded sandstone layer within the Magdalena formation. The sandstone is overlain by blue limestone. Shale occurs locally between the sandstone member and the underlying limestone.
>
> An adit about 30 feet long has been driven into the sandstone member where it outcrops on the approximate dip slope north of Arroyo

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[29] M. G. Huntington, mining engineer, 1942.

[30] J. H. Soule', mining engineer, 1943.

[31] Federal Bureau of Mines, ore-dressing report, Rolla, Mo., Station, 1943.

[32] Lasky, G., The Ore Deposits of Socorro County, N. Mex.: New Mexico Sch. Mines and State Bureau of Mines and Mineral Resources Bull. 8, 1932, p. 136.

[33] See work cited in footnote 30, p. 136.

[34] See work cited in footnote 30, p. 136.

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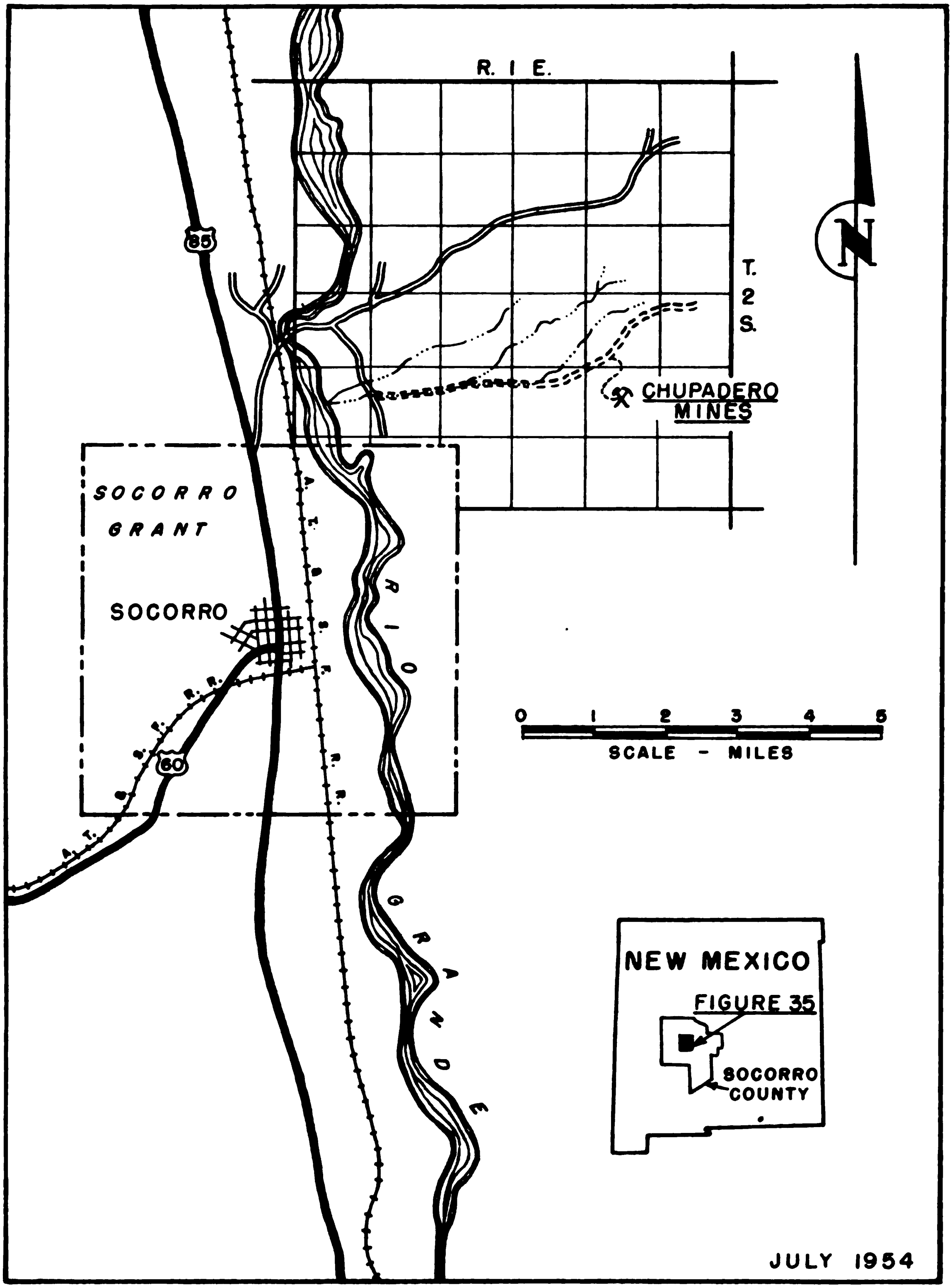

Figure 35. - Location map, Chupadero mine.

de los Pinos. A short distance up the hill a shaft collars in blue limestone and bottoms in the sandstone bed. On the other side of the ridge, which represents the scarp of a strong fault zone striking about N. 50° E., copper mineralization appears in sandstone within the fault zone. A little gypsum is present at this place in the vein, and some malachite has spread along the fault surfaces locally.

About a quarter of a mile south of the above deposit and just south of Arroyo de los Pinos, a short adit has been driven northwestward along the carbonate mineralization in what appears to be the same sandstone member. This sandstone outcrops along a fault scarp.

Deposits in Lincoln County

Only one area in Lincoln County is known to contain deposits of "Red Bed" copper. This is the Estey district in the extreme western part of the county. The deposits are situated about the center of T. 9 S., R. 6 E., and are accessible by a dirt road going west from Oscura, N. Mex. This area, the only one not visited, was left out because it is within the limits of the White Sands Proving Ground bombing range. The following description is quoted from the literature.35/

> Estey is 14 miles northwest of Oscuro, a station on the Southern Pacific Railroad (formerly the El Paso & Southwestern Railway). It lies at the southeastern edge of the Oscura Mountains, which extend southward from Socorro County. Although the presence of copper minerals has been known for many years, it was not until 1900 that an effort was made to mine the ore. The district has been idle for 20 years or more, and only a few carloads of ore have ever been shipped.
>
> The ore occurs in the Abo "Red Beds" formation, which is repeated at the surface by a number of faults. Ore is found at three horizons, the most important of which is the arkose at the base of the 'Red Beds'. The copper-bearing layers are thin, for the most part a few inches to 3 feet thick. Ore also occurs in cross fractures and prominent joints. Malachite is the chief ore mineral. The sulfide ore consists chiefly of chalcocite which has replaced the calcite cement of arkose and sandstone. The chalcocite is very commonly associated with coaly matter in the arkose and occurs also in rounded nodules in limestone. The ores carry a minor amount of silver and a trace of gold. No gangue minerals other than a small quantity of coal and other carbonaceous matter have been noted.

Deposits in Otero County

There are 3 districts in Otero County that contain "Red Bed" copper deposits. They are the Tularosa district, about 5 miles north of Tularosa, N. Mex.; the Bent district, about 12 miles northeast of Tularosa; and the Sacramento district, which is southeast of Tularosa and a few miles east of Alamogordo. The Bent and Tularosa districts often are considered as one. The copper deposits in the county, probably were prospected in a small way, or at least known, before the turn of the century. However, the first sizable production seems to have been derived from the Virginia

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35/ Lasky, S. G., and Wooton, T. P., The Metal Resources of New Mexico and Their Economic Features: New Mexico Sch. Mines and State Bureau of Mineral Resources Bull. 7, 1933, pp. 76-77.

mine at Bent. This mine was developed about 1904 and operated almost continuously until 1917.[36] Activity in the other districts has been sporadic and inconsequential.

Deposits North of Tularosa

There is very little in the literature on the copper deposits north of Tularosa. The deposits are in secs. 27, 32, 33, and 35, T. 13 S., R. 10 E., and are reached by going north on U. S. Highway 54 about 1 mile from Tularosa to just before the railroad overpass, turning right on a dirt road, and traveling northeast for 3.9 miles to the first mine workings south of the road. Other shallow workings may be seen between the first workings and an open pit, which can be reached by continuing on the road for nearly a mile, taking the left branch, and continuing north for nearly 1.5 miles. These are workings north and west of the road. (See fig. 36.)

A note from the old Bureau of Mines Silver City field office files indicates that there were 2 groups of claims, the Coyote and the Ozark, in this area 20 to 30 years ago. More recently, the Copper Queen group (1952) was situated in the northern part of the district and the Randy Shinnon group (1953) in the southern and western part of the district.

The predominant outcrops in the area are rocks of the Abo formation of Permian age. The sedimentary beds dip gently eastward in the western part of the district and are nearly flat lying to the northeast. A number of northeast-trending basic dikes traverse the area.

On the surface copper minerals are scarce and were noted in a shaly sandstone in the most southwestern workings. No copper minerals were noted in the open pit in the northern part of the area. Malachite was the predominant copper mineral seen, and chalcocite may have been present.

Other than widely scattered shallow pits, three caved adits in the southwestern part of the district and an open pit in the north were the prominent mine workings. The open pit, a recent operation, measured roughly 150 feet long by 15 feet wide and deep. An old shaft in the bottom of the pit extended the exploration depth an additional 20 feet for a total of about 35 feet.

Some churn drilling was done in the area about 1920. Two hole sites and a possible third were located. One was a short distance south of the open pit, the second was near the road forks in the center of the district, and a possible third may have been about a mile northeast of the caved adits. No drill cuttings could be examined; but, according to old records,[37] 2 holes were drilled to 440 and 535 feet, respectively.

The 440-foot hole reportedly contained 0.6 to 9.6 percent copper from 319 to 329 feet. The 535-foot hole contained 0.8 to 7.0 percent copper from 95 to 134 feet. The locations of the holes were not reported.

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[36] See work cited in footnote 33, p. 86.

[37] Notes for the files of the old Silver City, N. Mex., Field Office of the Federal Bureau of Mines.

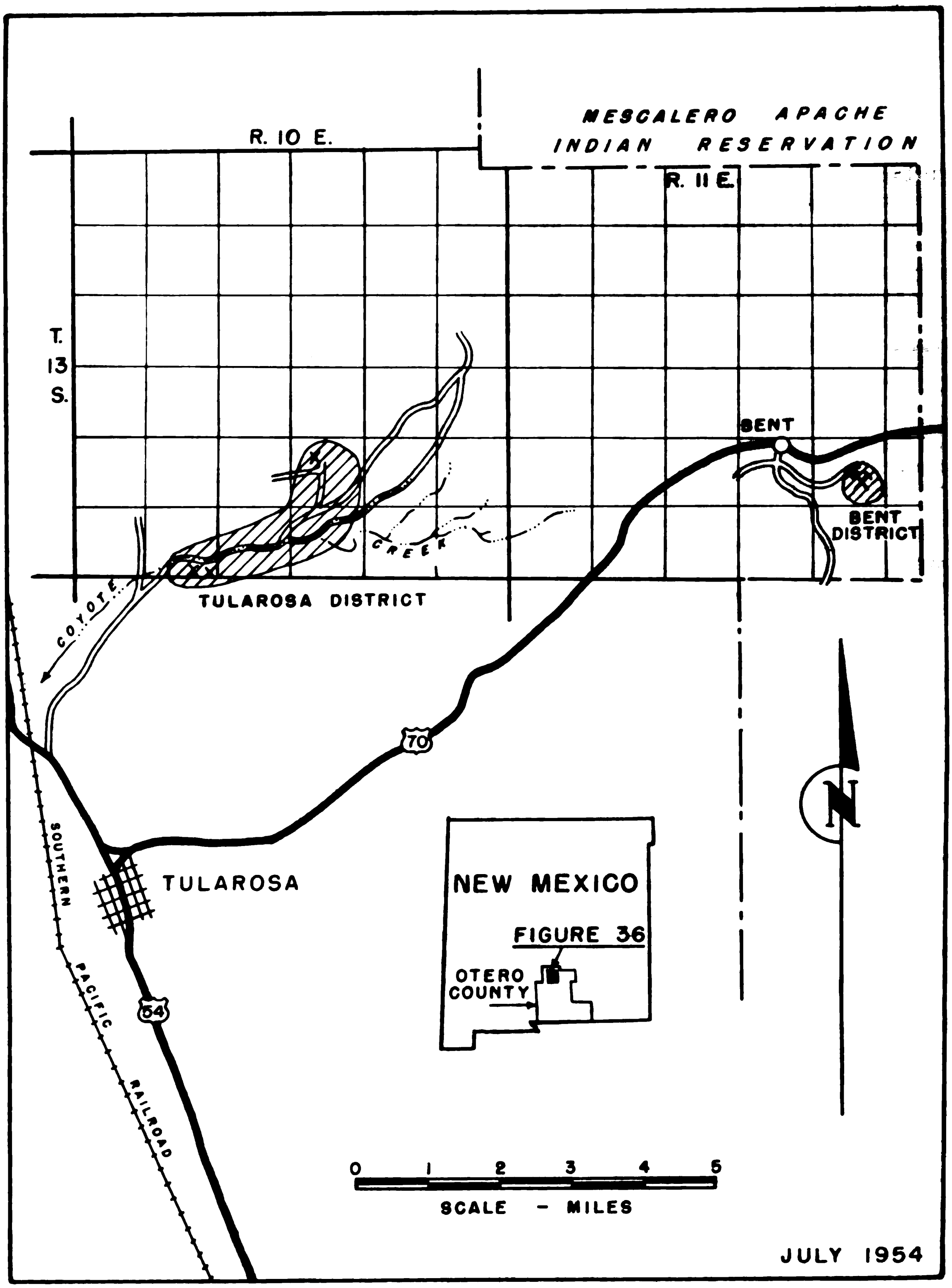

Figure 36. - Location map, Tularosa–Bent district.

Deposit Near Bent

The mine of the Old Tularosa Copper Co. is southeast of the Bent post office in sec. 26, T. 13 S., R. 10 E. It can be reached by going to Bent, N. Mex., on U. S. Highway 70 and on about 12 miles northeast of Tularosa, turning south off Highway 70 at the Bent post office, following the dirt road for 0.2 mile across Tularosa Creek, turning sharply to the left, and following up the south bank of the creek for 1 mile to the mine (see fig. 36).

The copper mineralization occurs in a sandstone bed, probably in the Chupadera formation of Permian age, as well as in veins in an underlying diorite intrusive that seems to have domed the sedimentary beds. Although the copper minerals - chalcocite, malachite, and azurite - in the sandstones are typical of the "Red Bed" copper occurrences, the close association with an intrusive and the silication of part of the sandstone place this deposit in a class by itself. The copper mineralization in the sandstone is patchy and streaky and seems to be of small extent. This property has a sizable record of production, and little accessible ore remains. One general sample was taken of the copper-bearing sandstone, and this sample contained 1.0 percent copper and traces of gold and silver. A black, resinous hydrocarbon was reported in the ores.[38/]

An open pit about 30 by 60 feet in plan and about 35 feet deep was the most evident mine working. Nearby were shafts with lateral workings, some of which connected with the pit. The lower workings were not examined because they were not safely accessible. A description of the workings is taken from the literature.[39/]

> Development: At the Virginia mine there is an open pit 60 x 120' across and 35' deep which is opened on the richest part of the deposit. The 1st level corresponds to the bottom of the pit; the 2nd level is 25' deeper. These workings are said to block out 85,398 tons of ore in an area of 105 x 180' in extent. Twelve diamond-drill holes from 88 to 400' deep prospect the ground, and the results form the basis for an estimate of 800,000 tons of indicated ore of an average value of 2-1/2% copper.

Deposits in the Sacramento District

"Red Bed" copper deposits in the Sacramento area are 1.5 to 22 miles south of High Rolls, N. Mex. Most of the deposits are in T. 16 N., R. 11 E., as shown on figure 37. The area is easily accessible, and most of the properties lie near the road. From Alamogordo, N. Mex., the approach is north on U. S. Highway 54-70 for 3 miles, then 9 miles east on State Highway 83 to High Rolls. This town is just north of the highway, and from here a forest road leads to the right off the paved road. The Thorny prospect is 1.5 miles from the turnoff, the Courtney mine is 3.4 miles, the Adycopt is 9.5 miles, and the Daugherty prospect miles and in San Andreas Canyon. This last-named prospect was not visited.

As previously mentioned, most of the deposits are in T. 16 N., R. 11 E. The Thorny prospect is in sec. 8, the Courtney mine in sec. 17, the Speckled Bird in sec. 19, the Adycopt in sec. 32, and other unnamed prospects in secs. 8, 17, and 30.

[38/] Work cited in footnote 32, p. 87.
[39/] The Mines Handbook and Copper Handbook: Vol. 13, 1918, p. 1236.

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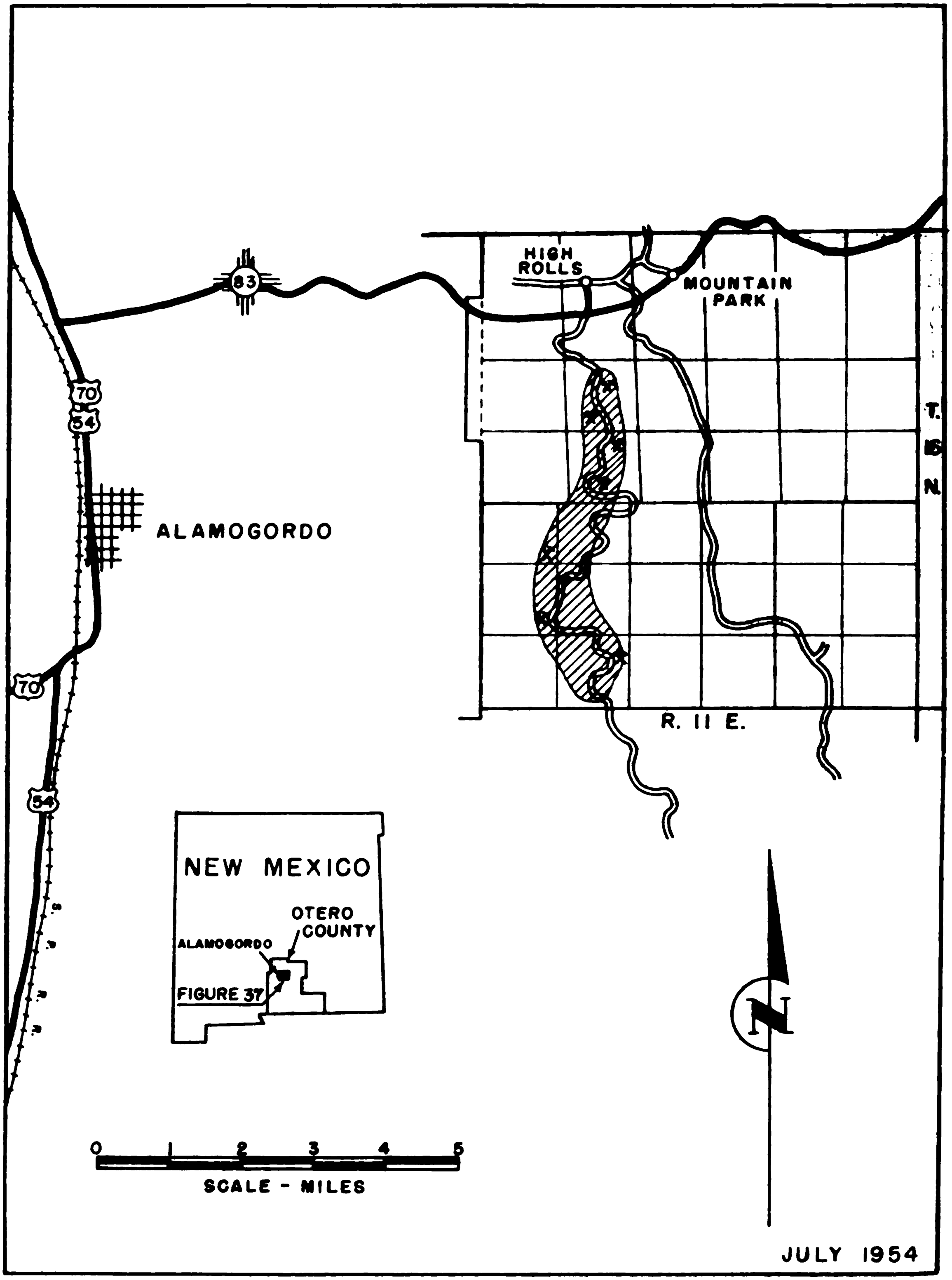

Figure 37. - Location map, Sacramento district.

All of the deposits occur in the Abo formation of Permian age. The beds dip generally east or northeast at from 5° at the Speckled Bird to 25° or 30° at one of the unnamed prospects. The beds at the Courtney mine dip east about 15°, but this dip may be unreliable because of structural deformation. The beds in the Adycopt area dip northeast about 10°.

The copper mineralization occurs in sandy shales and arkose grits of the Abo formation. The copper minerals are chalcocite, malachite, azurite, chrysocolla, and melaconite. The chalcocite occurs as nodules, blebs, and patches. The oxidized minerals occur the same as the chalcocite and, in addition, as patches, streaks, and disseminations in the arkose.

Thorny prospect. - The copper mineralization occurs as chrysocolla in an arkose grit-conglomerate. Mineralization is patchy and of small extent. Development was by short crooked adits.

Speckled Bird prospect. - The mineralization consists of nodules of chalcocite coated with malachite and azurite. The nodules of mineralization vary from 1/2 to 6 inches in diameter and give the arkose a speckled appearance, hence the name of the property. South and east of this occurrence another exposure shows nearly pure chalcocite as small, thin lenses.

Development was by adits, one 45 feet deep and another 110 feet deep. Three samples were taken by a Bureau of Mines engineer,[40] and the results obtained are shown in the following table:

TABLE 6. - Sampling at the Speckled Bird prospect

Location of sample, feet from portal	Width, feet	Copper, percent	Silver, ounce per ton
70	3	0.70	0.12
50	2.5	1.41	.56
20	2.5	.61	.20

Courtney mine. - The Courtney mine possibly can be credited with the largest production of copper from the district. The copper minerals observed were chalcocite, malachite, and azurite. The chalcocite occurred in a thin, undulating bed of sandy shale. Oxidation of part of the chalcocite resulted in malachite and azurite that occur in the sandy shale and as disseminations in the coarser adjacent rocks. The mineralized zone may average 2 feet in thickness where exposed in the open pit. Some carbonaceous material was observed, and its replacement by chalcocite was unimportant.

The sedimentary beds are locally flexed, and this seems to be caused by a bedding-plane fault.

The mine workings consisted of an open pit about 60 feet in diameter with stopes and inclined shafts developing the ore zone to about 100 feet down dip. One vertical shaft intersected the ore body at about 100 feet down dip from the outcrop. To the southwest, an inclined shaft was sunk in barren, sandy shale. In 1929 a few cars of ore containing about 3.3 percent copper were shipped from the property.

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[40] R. J. Holmquist, 1943.

Other prospects. - The Ady Cupb[41] or Adycopt[42] prospect probably is the most developed of any in the district. Several shallow pits and an inclined shaft over 1,200 feet deep comprise the mine workings. The shaft starts as an adit for about 100 feet then dips about 9°, slightly crosscutting the sedimentary beds as it deepens. The shaft is slightly flatter than the beds.

Chalcocite, malachite, and azurite were the observed copper minerals and occur in an arkose grit as narrow bands of 6 to 8 inches thick. The bands are not more than a few feet long. Fracture filling, replacement of the cementing material, and interstitial filling with oxidized copper minerals were noted but were not prominent. Much carbonaceous material was seen, but it seemed to be unimportant with respect to copper deposition. However, according to Fischer, this mine is interesting for the unoxidized ores present at depth and for the presence of carbonaceous material.

Other prospects in the district were examined and were, for the most part, unimportant. Generally, they consist of a slight amount of malachite disseminated in coarse arkose.

Between the Courtney and Adycopt mines are the Warnock and Holmes mines. These mines are noted for the occurrence of galena in sandstone. The lead production of the district far exceeds that of copper - 1,600,000 pounds of lead as against 100,000 pounds of copper to 1932.[43]

Deposits in Eddy County

The Lone Eagle (Golden Eagle or Ammon) mine is in the SW1/4 sec. 14, T. 21 S., R. 25 E., about one-fourth mile by road northwest of Carlsbad, N. Mex. The property is reached by U. S. Highway 285 and the branch road shown on figure 38.

Several attempts have been made to operate the Ammon property, but only small token shipments resulted from such attempts. A small, crude smelter was erected at the mine, but its operation was short lived.

The copper mineralization occurs as malachite, disseminated in a sandstone member of the Yeso formation of Permian age. The areas of mineralization are small; two have been noted in close proximity. The malachite is distributed fairly evenly throughout the sandstone, and it would be difficult to sort out high grade for shipment to a smelter. The malachite seems to be a replacement of the cementing material of the sandstone.

The sandstone beds generally are flat lying but are sharply folded or faulted where mineralized. Development was by an inclined shaft that flattens with depth. This shaft may have been 60 feet deep and is now partly filled with debris. About 150 feet north of the collar of the shaft was a shallow pit about 6 feet deep. This pit was about 10 by 15 feet in plan (see fig. 39). The mineralization is the same as in the shaft. Some ore was stockpiled, and this was sampled. One sample of the stockpile was taken, and another was taken from the dump of the shaft. These contained 2.0 and 2.51 percent copper and only traces of gold and silver.

About 7 miles to the west and approximately in sec. 34, T. 21 S., R. 24 E., a recently discovered deposit was reported while prospecting was being done for uranium. The deposit was not visited and is presumed to be similar to the Ammon.

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[41] Fischer, R. P., Sedimentary Deposits of Copper, Vanadium-Uranium, and Silver in Southwestern United States: Econ. Geol., vol. 32, No. 7, 1937, p. 919

[42] The Mines Handbook, vol. 18, 1931, p. 1655.

[43] See work cited in footnote 33, p. 86.

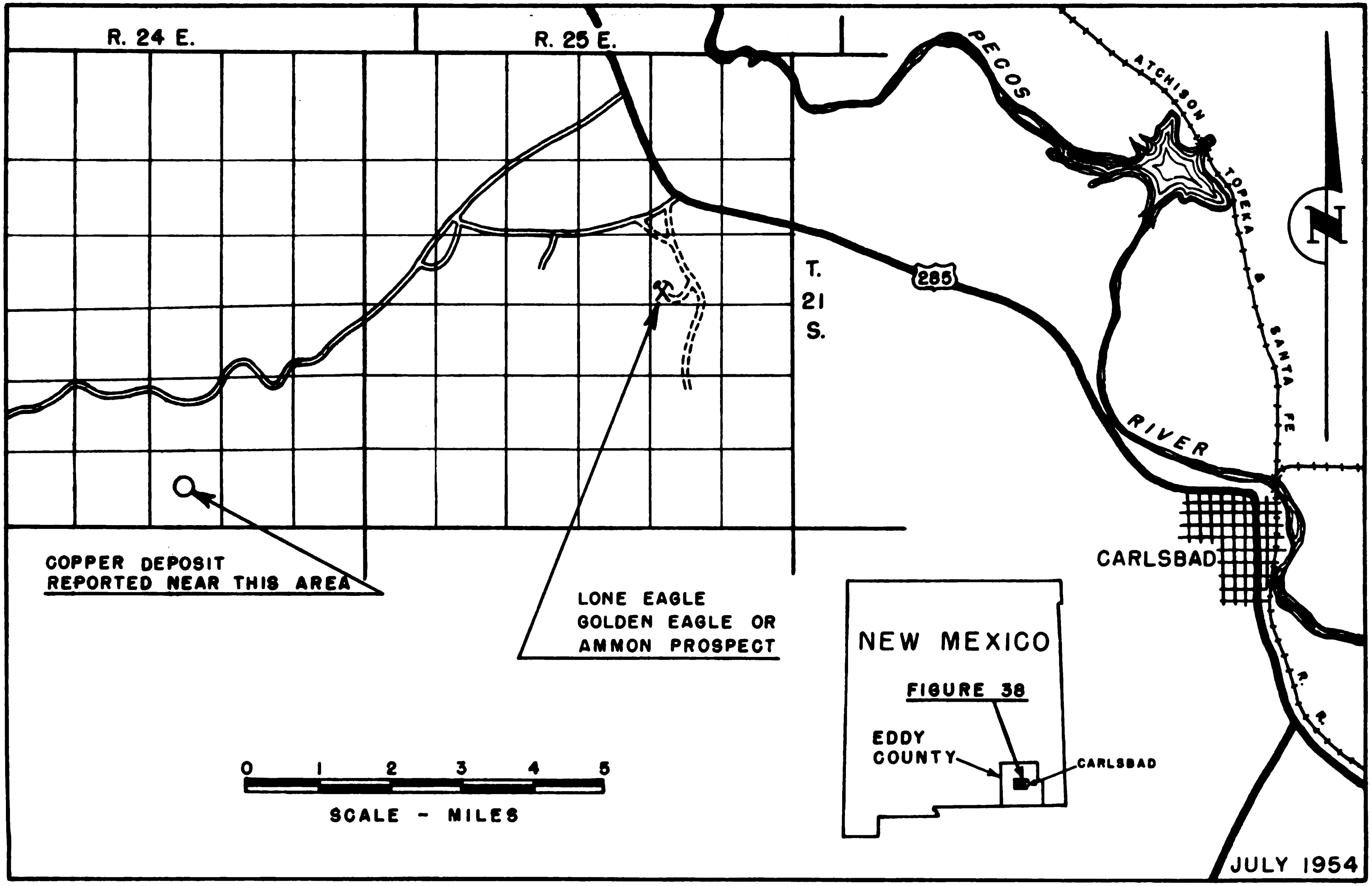

Figure 38. - Location map, Eddy County deposits.

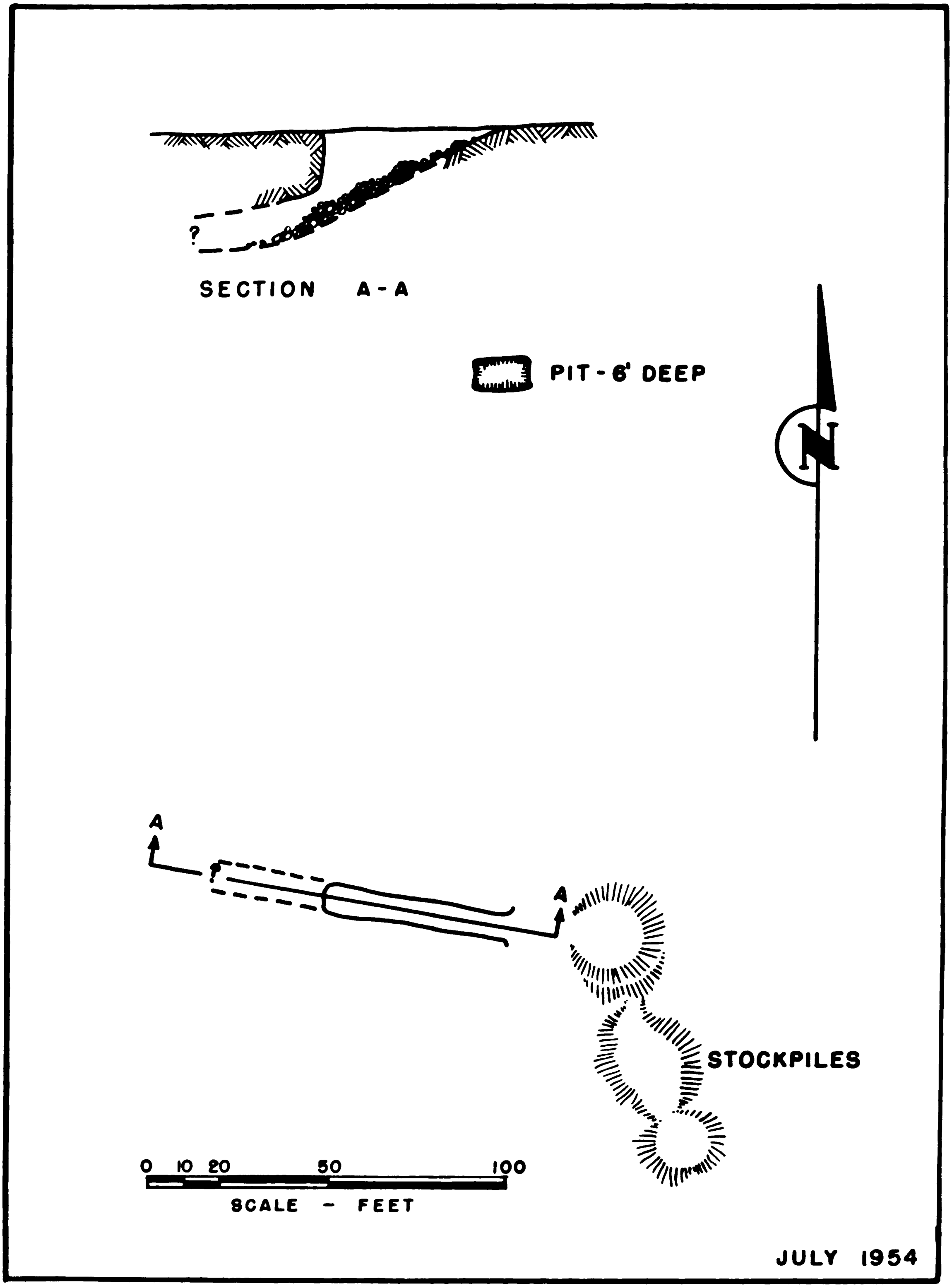

Figure 39. - Sketch plan and section, Lone Eagle (Ammon) prospect.

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